Machine-Detector Interface

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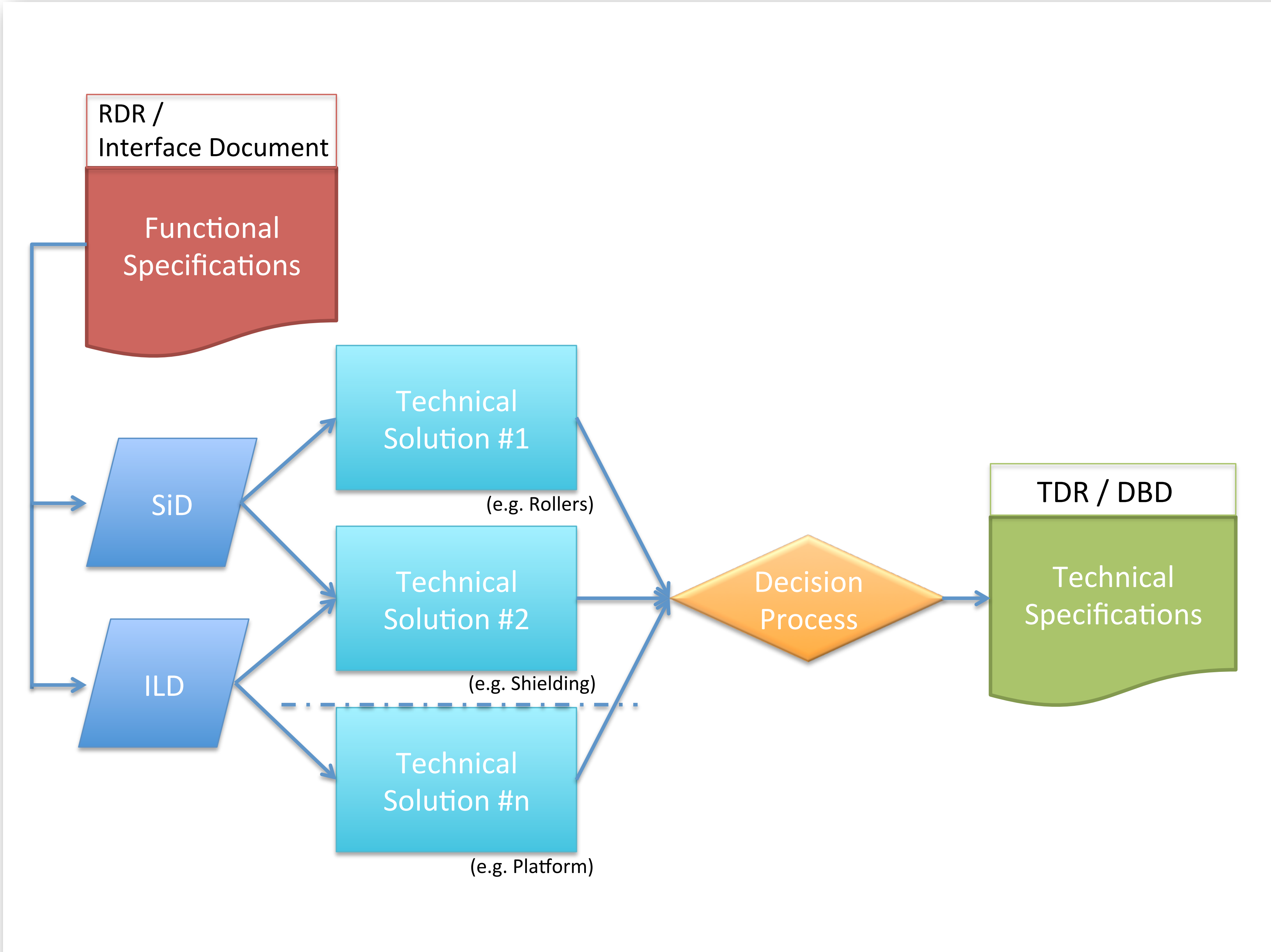
DESY

PAC Review
Prague
14th November 2011

Machine-Detector Interface Organisation

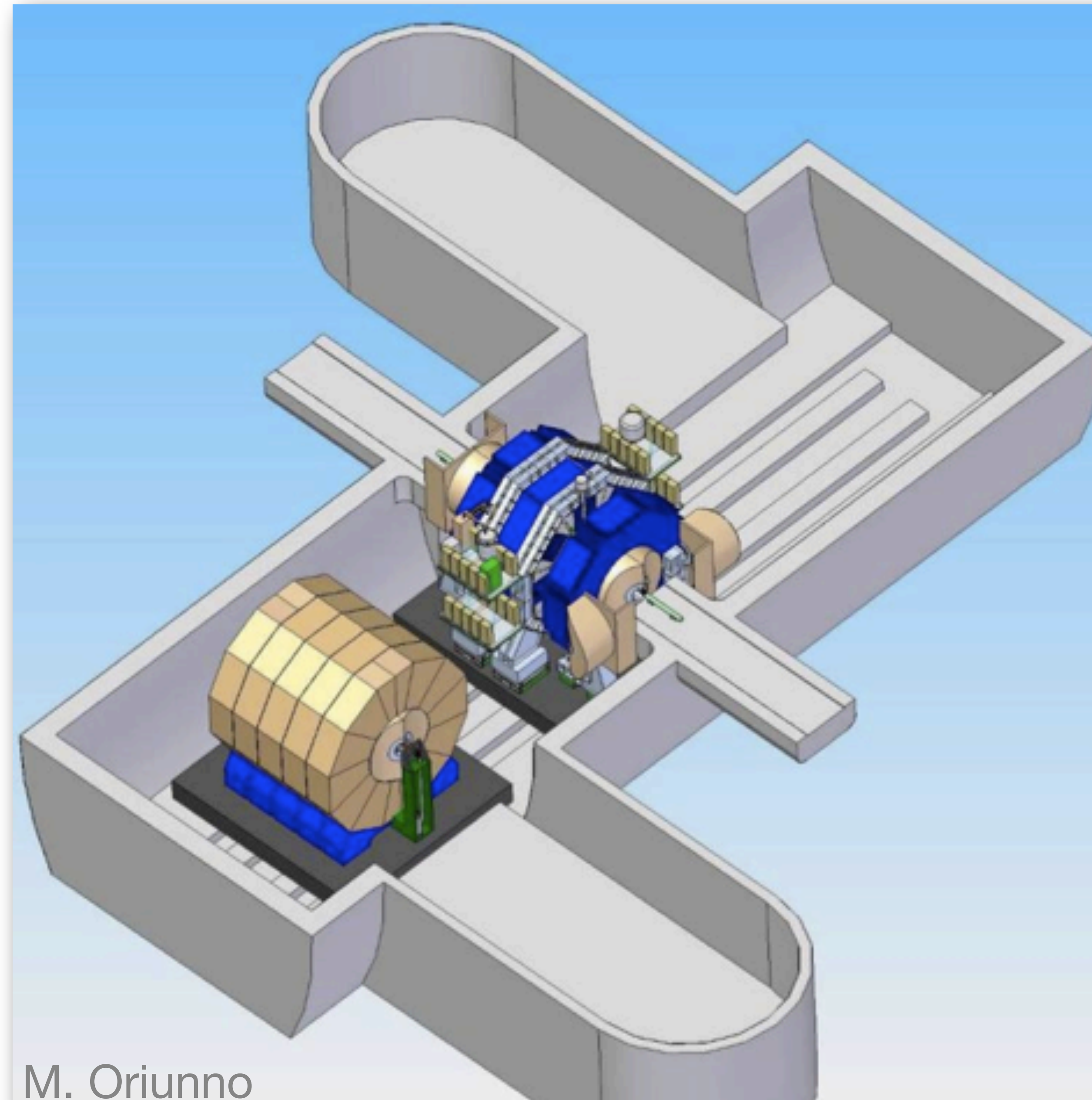
- A fruitful collaboration between:
  - MDI Common Task Group - Detector Organisation
  - BDS and CFS groups - GDE
  - SiD and ILD - Detector Concepts
  - close thematic links to CLIC
- No single line of reporting
- Depends on decision making in „experimental collaboration style“
  - authoritative measures are limited
  - common agreements wherever possible



Discussion and decision work flow

MDI Main Topics

- Resources are limited
- Concentrate on topics that are of most relevance for the TDR/ DBD
- Concentrate on cost drivers
  - Civil facilities at the IR:
    - underground areas
    - surface buildings
  - Push-pull system
  - Detector services



Boundary Conditions

- IR Interface Document
  - Functional requirements for the co-existence of two experiments and the machine in a push-pull scenario
  - ILC-Note-2009-050
  - Major milestone and deliverable

ILC-Note-2009-050
March 2009
Version 4, 2009-03-19

Functional Requirements on the Design of the Detectors and the Interaction Region of an e^+e^- Linear Collider with a Push-Pull Arrangement of Detectors

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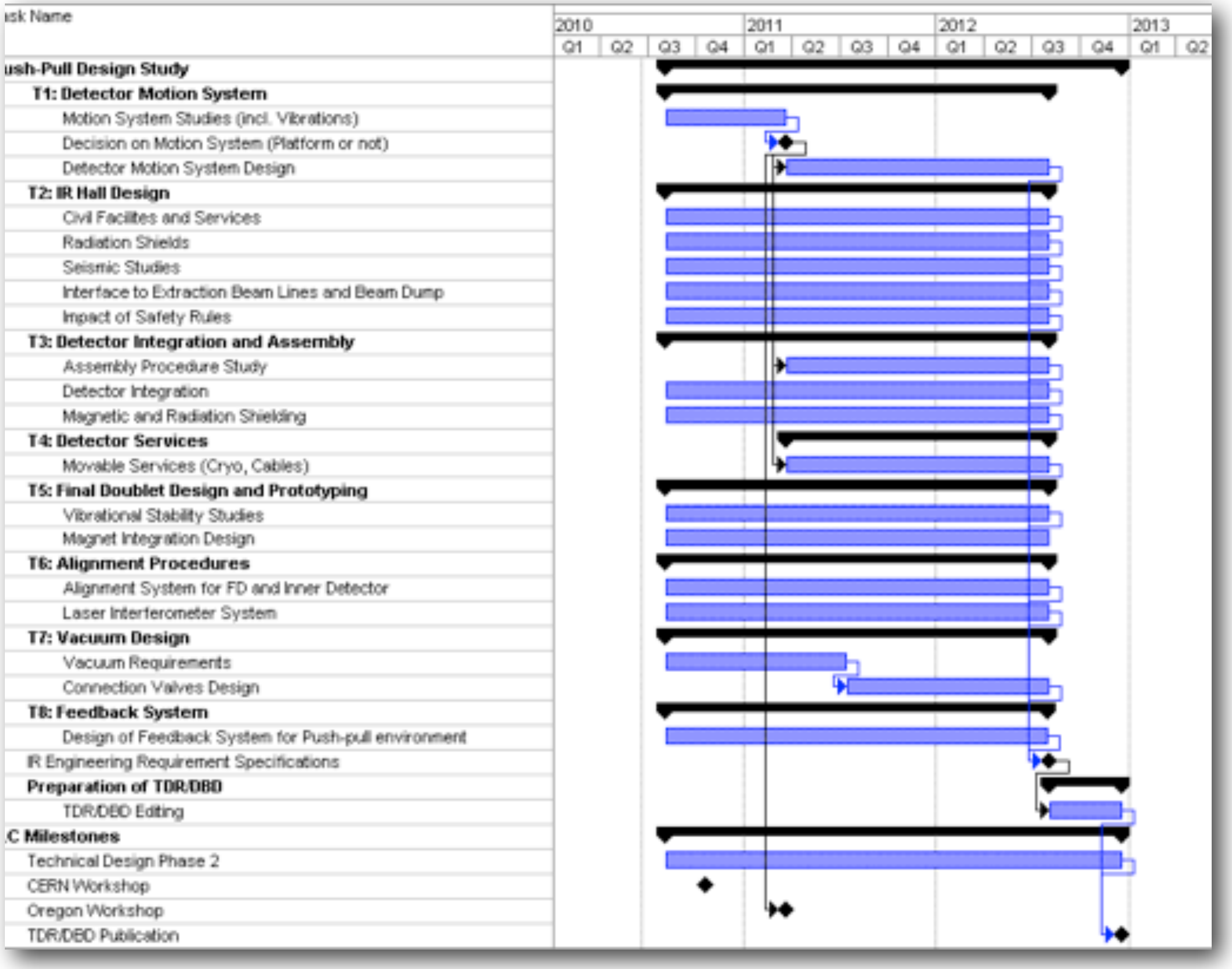
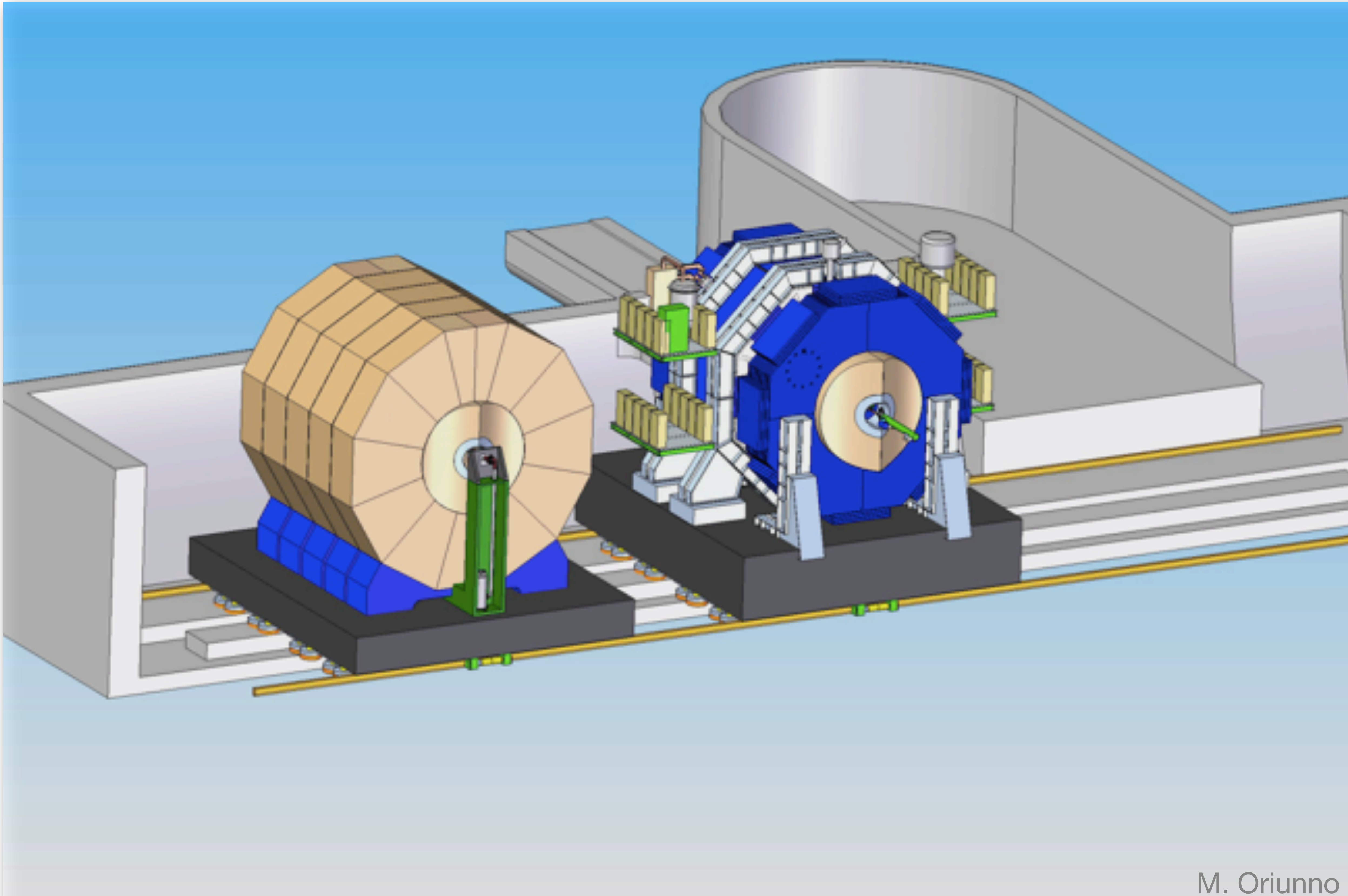
Abstract
The Interaction Region of the International Linear Collider [1] is based on two experimental detectors working in a push-pull mode. A time efficient implementation of this model sets specific requirements and challenges for many detector and machine systems, in particular the IR magnets, the cryogenics and the alignment system, the beamline shielding, the detector design and the overall integration. This paper attempts to separate the functional requirements of a push pull interaction region and machine detector interface from any particular conceptual or technical solution that might have been proposed to date by either the ILC Beam Delivery Group or any of the three detector concepts [2]. As such, we hope that it provides a set of ground rules for interpreting and evaluating the MDI parts of the proposed detector concept's Letters of Intent, due March 2009. The authors of the present paper are the leaders of the IR Integration Working Group within Global Design Effort Beam Delivery System and the representatives from each detector concept submitting the Letters Of Intent.

Work Plan

- 2010 design study proposal for the push-pull system
- Request for additional resources partially succesful
  - additional FTEs at KEK, SLAC, BNL, CERN
- Major milestone:
  - March 2011 agreement on platform-based detector motion system





Platform-based detector motion system

Engineering Specifications

- Ongoing work within the MDI Common Task Group
  - Compiled by T. Tauchi
  - ILC-EDMS ID 967835
- Will be main supporting specification for TDR/DBD
- Takes into account modifications for mountainous sites

9 November, 2011

Engineering Specifications (2) : Experimetnal Hall	RDR	SiD	SiD in Mtn. site	ILD	ILD in Mtn. site
Parameters that define the underground hall volume					
IR Hall Area(m) ; (W x L)	25x120		25x110		25x110
Beam height above IR hall floor (m)	8,6	9(7.5)	9(7.5)	8(9)	9
IR Hall Crane Maximum Hook Height Needed(m)	20,5	5m above top of detector	5m above top of detector	20,5	20,5
Largest Item to Lift in IR Hall (weight and dimensions)	400t	380t(HCAL)	380t(HCAL)	55t, 3x3x1.5m	400t
IR Hall Crane	400t+2*20t	400t(200tx2)/10t	400t(200tx2)/10t	80t(40tx2)	(200t+20t)x2
IR Hall Crane Clearance Above Hook to the roof (m)	14.5(includes arch)			6	12,5
Survice caverns(m) ; (W x L xH)	none			15x25x11	15x25x11
Resulted total size of the collider hall (W x L x H)	25x120x39	20.2x90x30	25x110x33	29x100x30	25x110x33
Area at garage position		19x 55.5	with side cavern	with side cavern	with side cavern
Parameters that define dimensions of the IR hall shaft and the shaft crane					
Largest Item; Heaviest item to Lower Through IR Shaft (weight and dimensions)	9x16m, 2000t	2500t	-	3500t, 15.7x7.81m	-
IR Shaft Size : diameter(m)	16	18	-	18	-
IR shaft fixed surface gantry crane. If rented, duration	1.5 years	1.5 years	-	1.5 years	-
Surface hall crane should serve IR shaft	Yes	Yes	-	Yes	-
Other shafts near IR hall for access	No	Yes	-	No	-
Elevator and stares in collider hall shaft	Yes	?	-	Yes	-
Size of access tunnel at Mtn. site (W x H, m)	-	-	11x11, 10.2x8.0	-	11x11, 10.2x8.0
Inclination of access tunnel at Mtn. site (%)	-	-	< 7	-	< 7
Length of access tunnel at Mtn. site (km)	-	-	1,5	-	1,5
Parameters that define dimensions of the surface assembly building and its crane					
Surface Assembly Building Area ((W x L , m)	25 x 100 / detector			30x60	27x100 / detector
Largest Item to Lift in SurfAsm. Bldg. (weight and dimensions)	400t	380t(HCAL)	(solenoid)	180t	400t, 8.6ϕx8 (solenoid)
Surface Assembly Crane	400t+2*20t	400t(200tx2)/10t	400t(200tx2)/10t	2x80t	(200t+20t)x2
SurfAsm. Crane Maximum Hook Height Needed(m)	18	20	20	19	20,5
SurfAsm. Crane Clearance Above Hook to the roof (m)	7			5m to ceiling	6,5
Resulted volume of surface assembly building (W x L x H, m)	25 x 100 x 25			30x60x24	27x200x27
Parameters that define crane access area and clearance around detector					
SurfAsm. crane accessible area (needed) / available (W x L, m)	20 x 102			28x56	
IR hall crane accessible area (needed) / available (W x L, m)	22 x 98		18x98	28x41	18x98
Maximum Detector Height(m)		16,15	16,15	15,74	15,74
Detector Width (m)		18.53(14.334)	18.53(14.334)	15,665	15,665
Minimum Detector Clearance (W x L x H, m)				15.67x13.26x15.74	15.67x13.26x15.74
FILL IN OTHER IMPORTANT PARAMETERS WHICH ARE MISSING					
Maximum AC power (MW)	-				
Temerature control (ºC)	-				
Humidity control (%)	-				
Sump Pump Control System (ground water)	-				
Cryogenics system : 4K He liquefier and large dewar	-	same level as the coil	same level as the coil	service cavern	service cavern
Dump registor	-	on the detector	on the detector	service cavern	service cavern

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ILC Source/RTML/BDS+MDI Technical Baseline Review

24-27 October 2011 *Universe*

Europe/Berlin timezone

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  - Registration Form
- List of registrants
- Video Services
- Accommodation
- How to get there

This workshop represents the second comprehensive **Baseline Technical Review**, following on from the Damping Ring BTR held in INFN Frascati in July. The main goal of the BTRs is to formally establish a consensus baseline for the ILC TDR. The workshop will cover four Accelerator Systems:

1. Electron source
2. Positron source
3. RTML (including bunch compressor)
4. BDS and MDI (including detector hall)

The review will in general focus on the following themes:

- Parameters, lattice and layout
- Technical systems (magnets, power supplies, RF, vacuum etc.)
- Key technologies (R&D, with a view to down-select if required)
- CFS requirements and specifications
- Cost.

In addition to these general themes, key issues specific to individual accelerator systems will be addressed. A particular emphasis will be placed on formal documentation, ready for inclusion in EDMS.

http://ilcagenda.linearcollider.org/event/5222
Last modified: 27 October 2011 17:54

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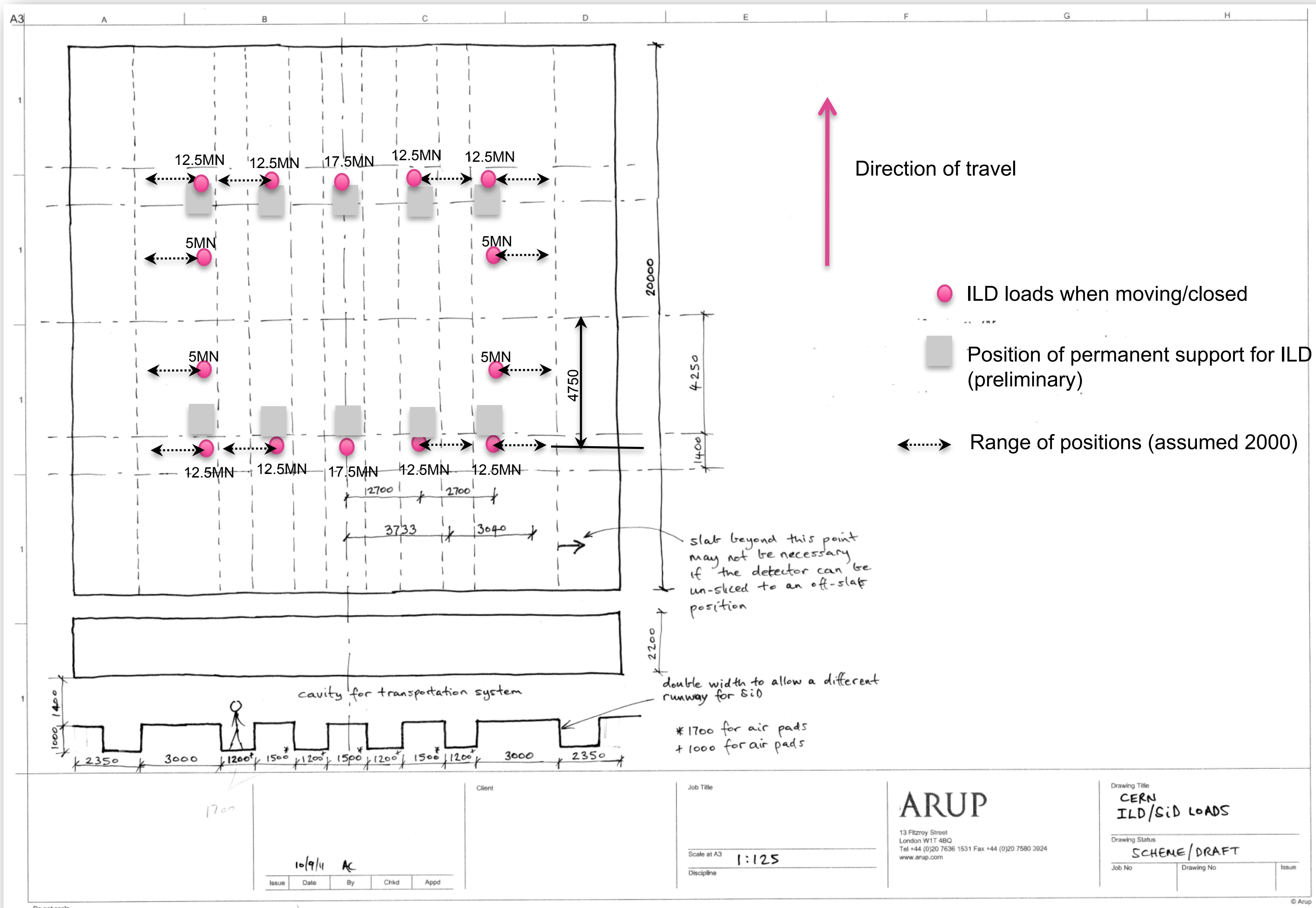
CFS Interaction Region Studies

- Launched study with contractor ARUP on two tasks:

  - Task 1: Design concept for detector movement platform
  - Task 2: Layout of CLIC complex based on CERN geology

  - Joint ILC/CLIC CFS initiative

ARUP Task 1: Platform Design

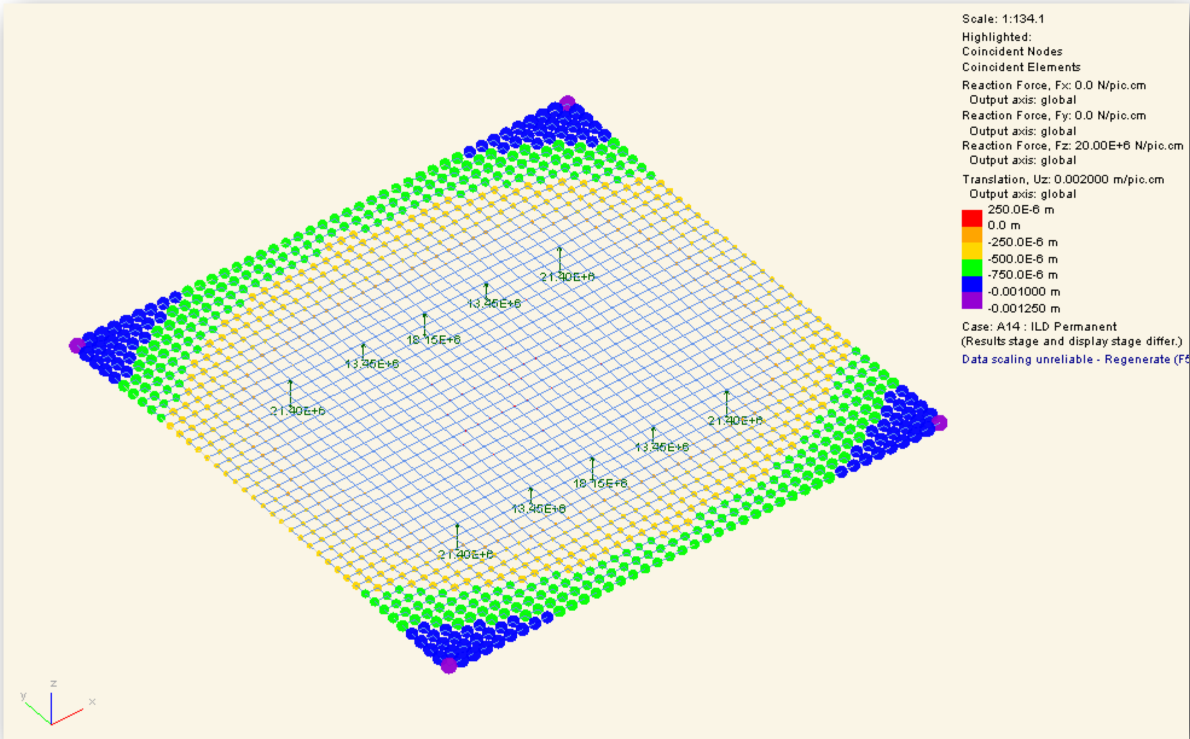


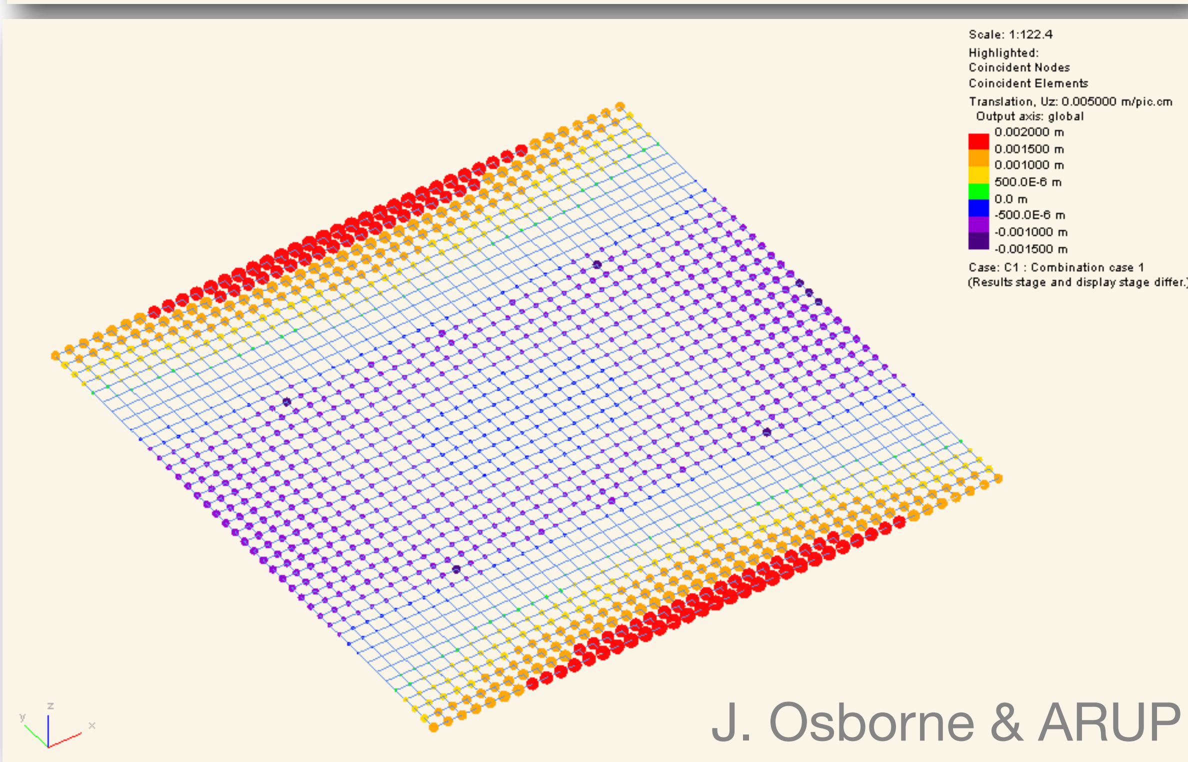
J. Osborne & ARUP

- ILD is the bigger challenge: heavier and larger than SID:
  - Thinner platform at same beam height
  - Larger loads on platform

ARUP Task 1: Platform flexures

- Unloaded platform:
  - Flexure: +0.25mm; -1.25mm
- Loaded platform jacking onto transport system:
  - Flexure: +1.9mm; -1.0mm





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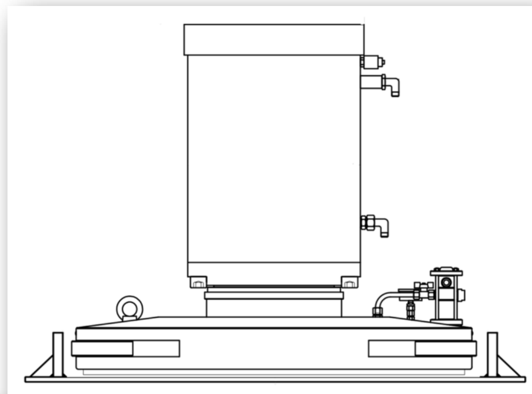
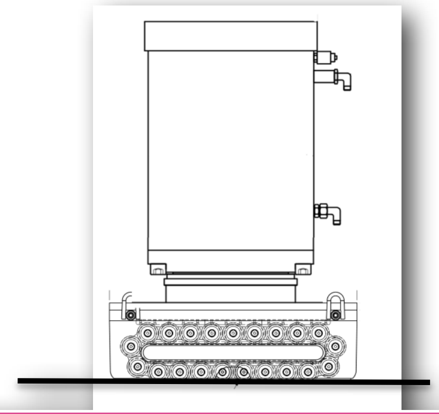
ARUP Task 1: Detector Movement System





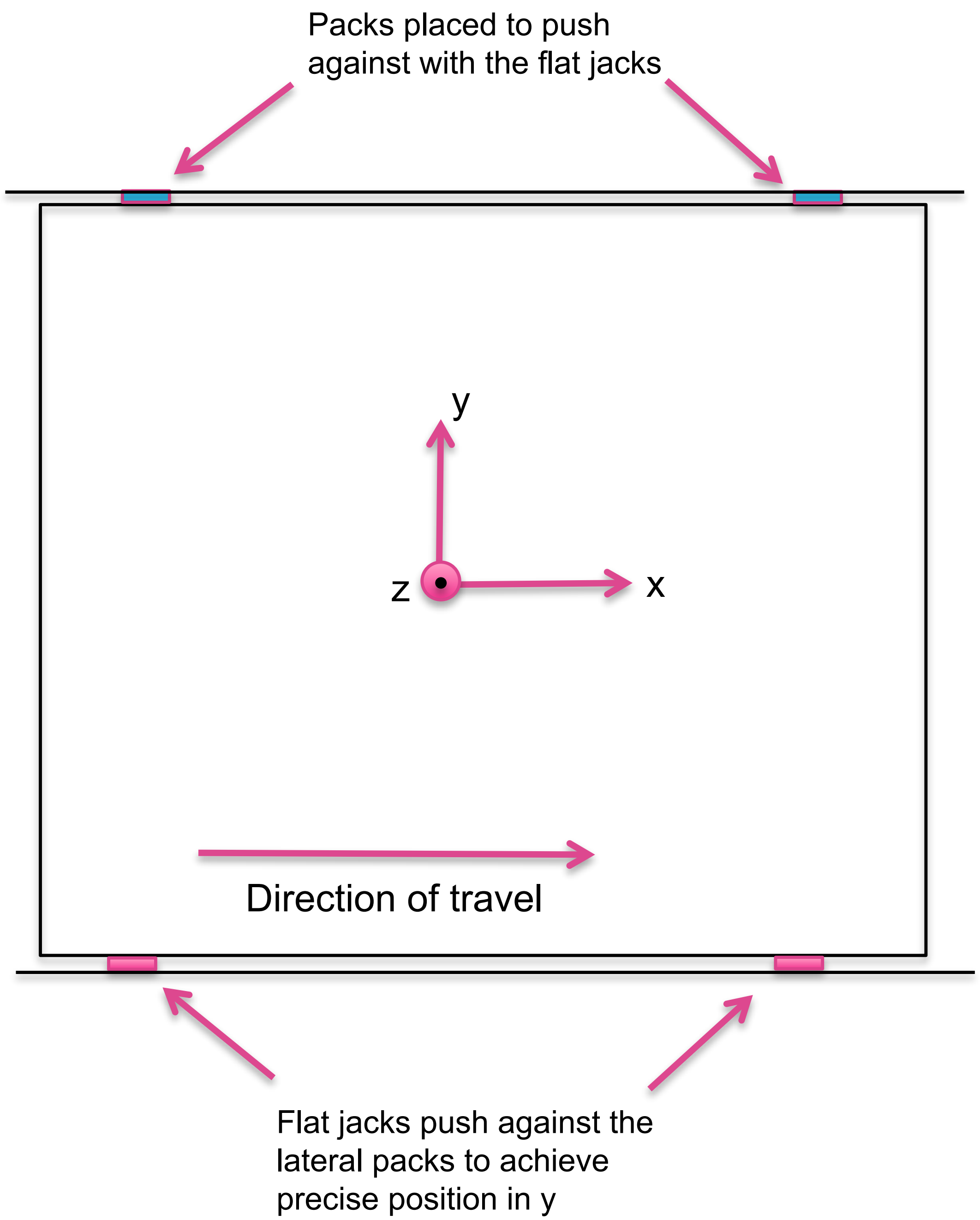
Pads	Rollers
Min 60 required (for ILD, no redundancy)	Min 18 required (for ILD)
No hardened track->can accommodate minor steps	Specialist hardened and flattened track
Design for 1% friction	Design for 3% friction
Pressure infrastructure	Larger propulsion infrastructure
Run-away	Higher friction ->less run-away

J. Osborne & ARUP

- Two solutions under study:
  - Air pads
  - Hilman rollers

ARUP Task 1: Positioning System

The final positioning system



Degree of freedom	Methodology
x, Rzz	Push pull system
z, Rxx, Ryy	Pack adjustment under slab
y (air-pads) *illustrated*	Lateral push with flat jacks whilst air pads are active
y (rollers) *illustrated*	Lateral push with flat jacks whilst the lateral slider (on the roller) is un-locked

Note, Rxx is rotation about the x-axis, etc

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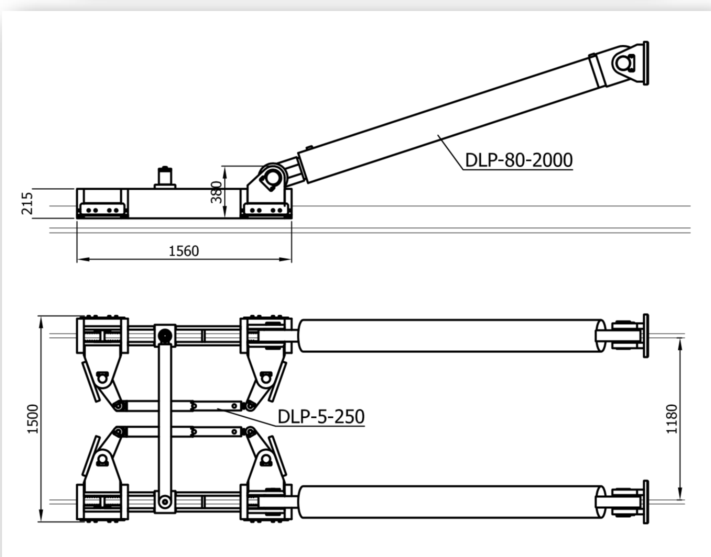
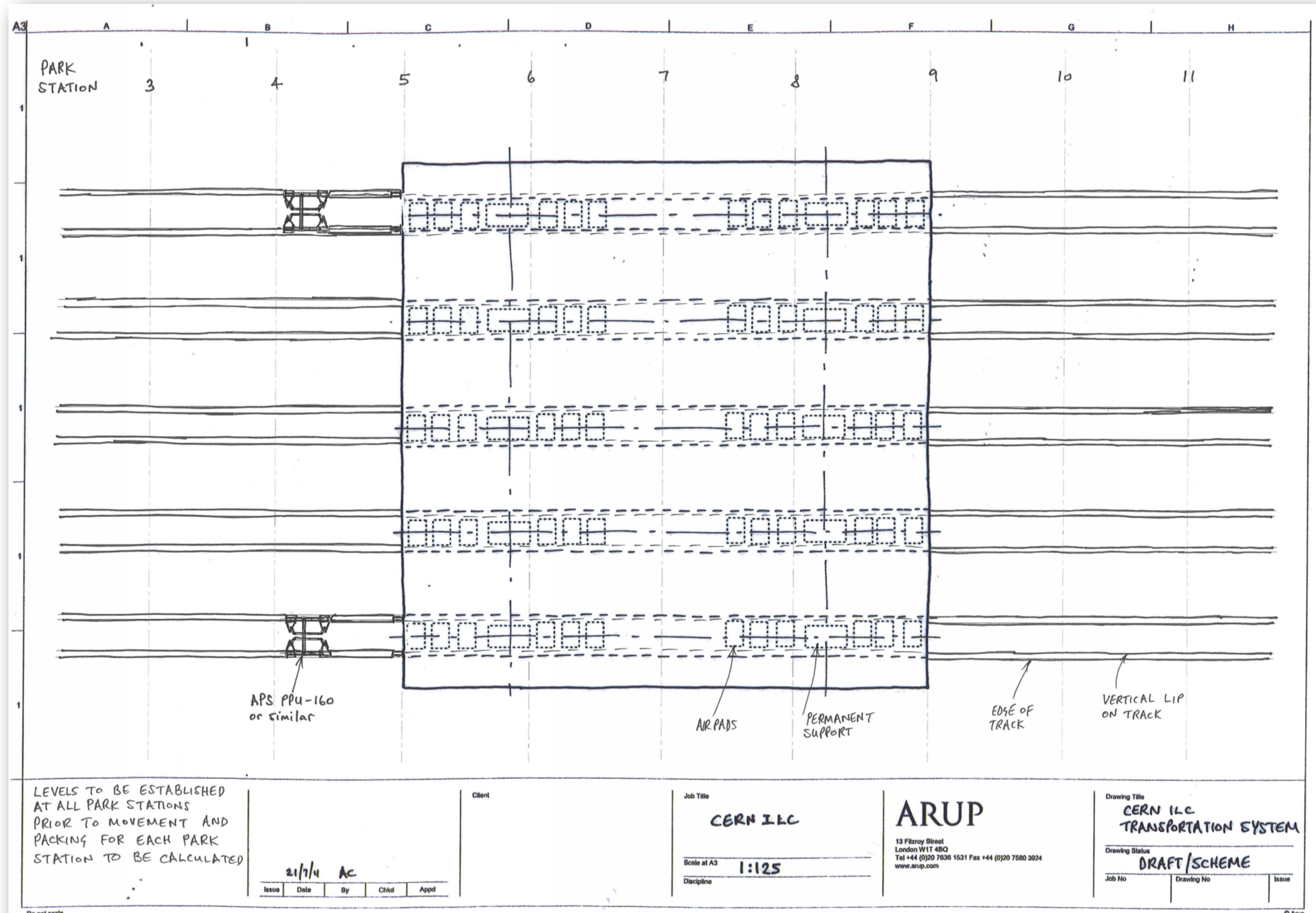
ARUP Task 1: Drive System





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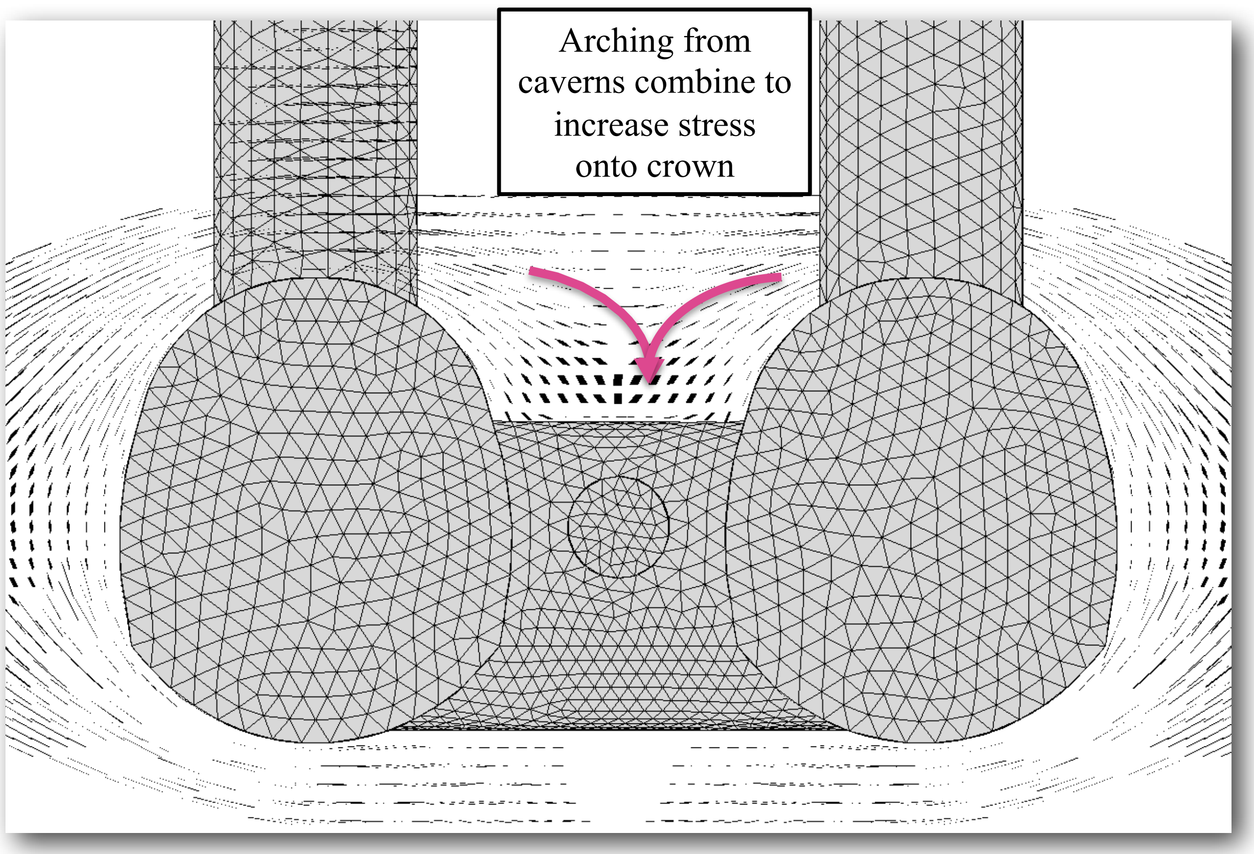
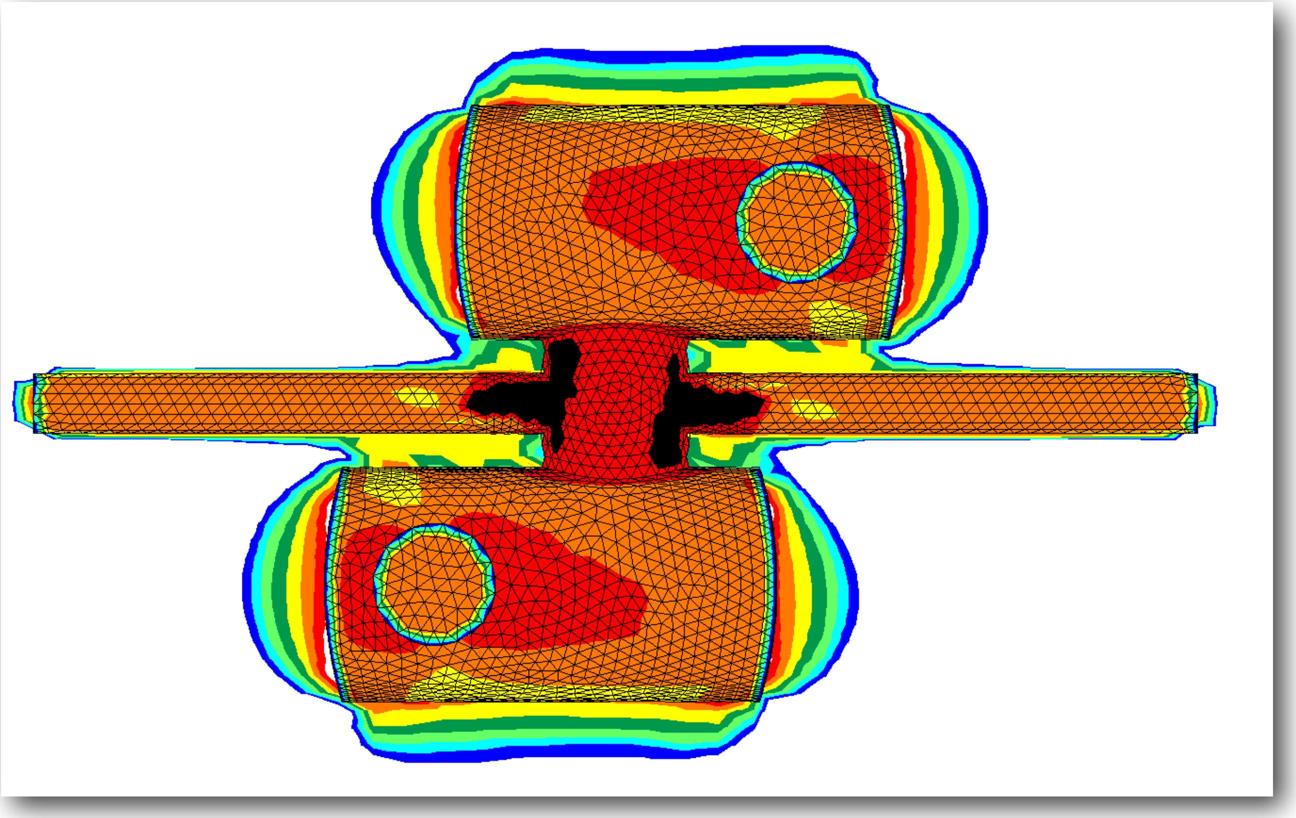
- Air pad drive system using grip jacks

ARUP Task 2:
CLIC Underground Hall





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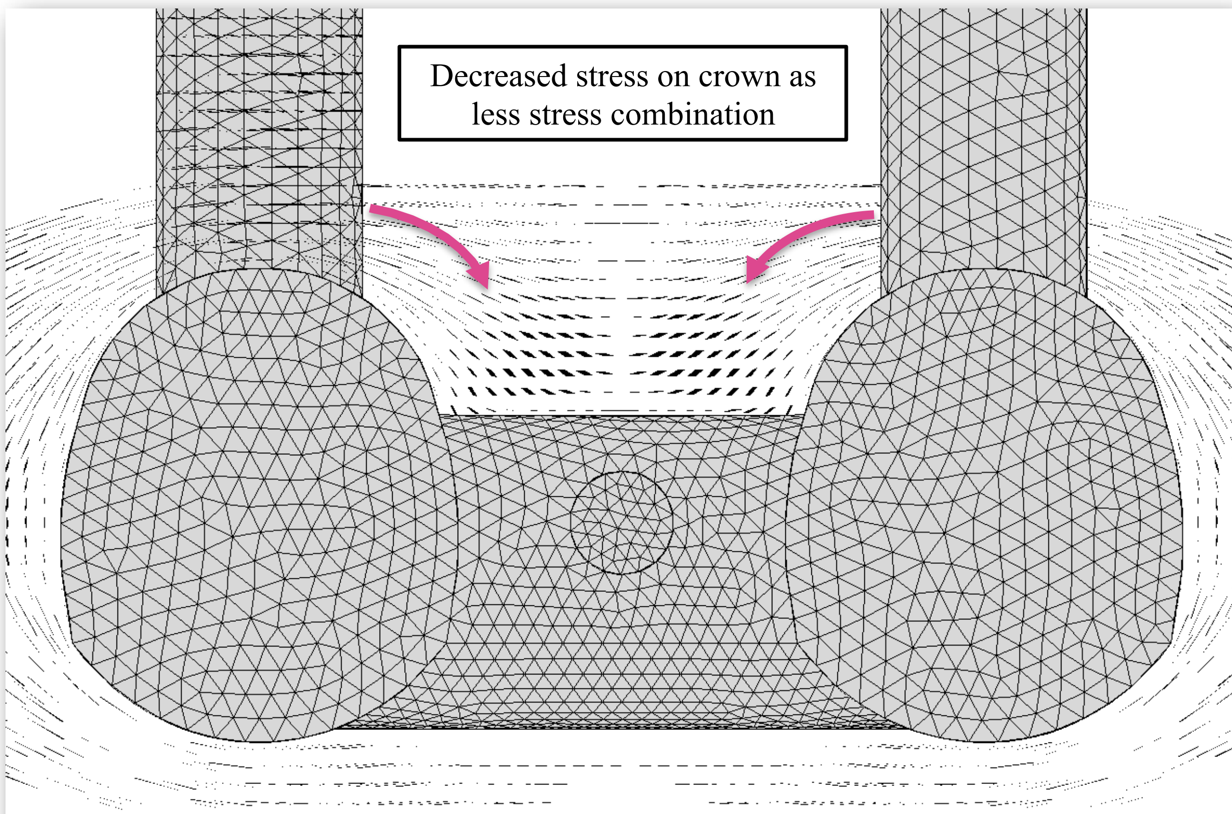
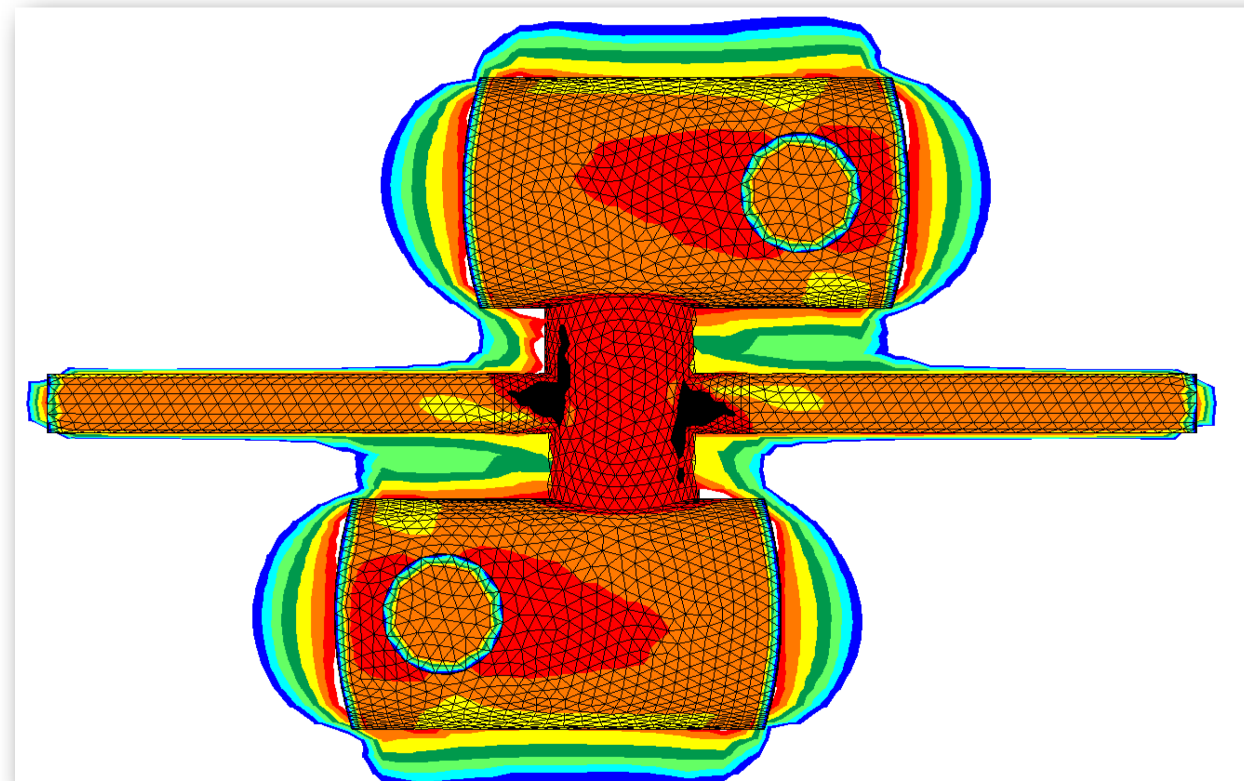
- Layout of CLIC underground hall in CERN geology
- Higher stresses mean more complicated lining and rock support and higher risk of rock yield

ARUP Task 2: CLIC Underground Hall



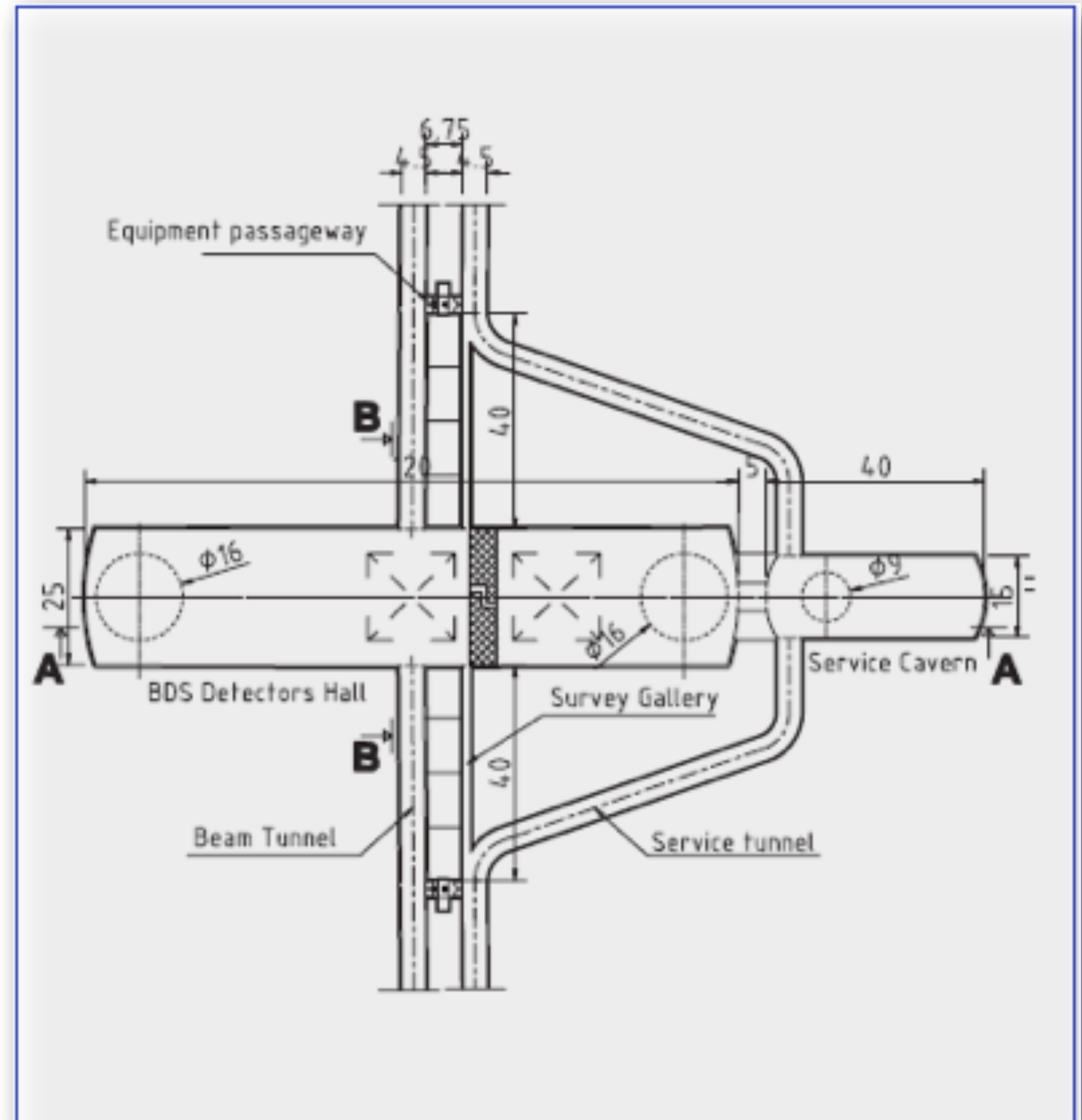


J. Osborne & ARUP

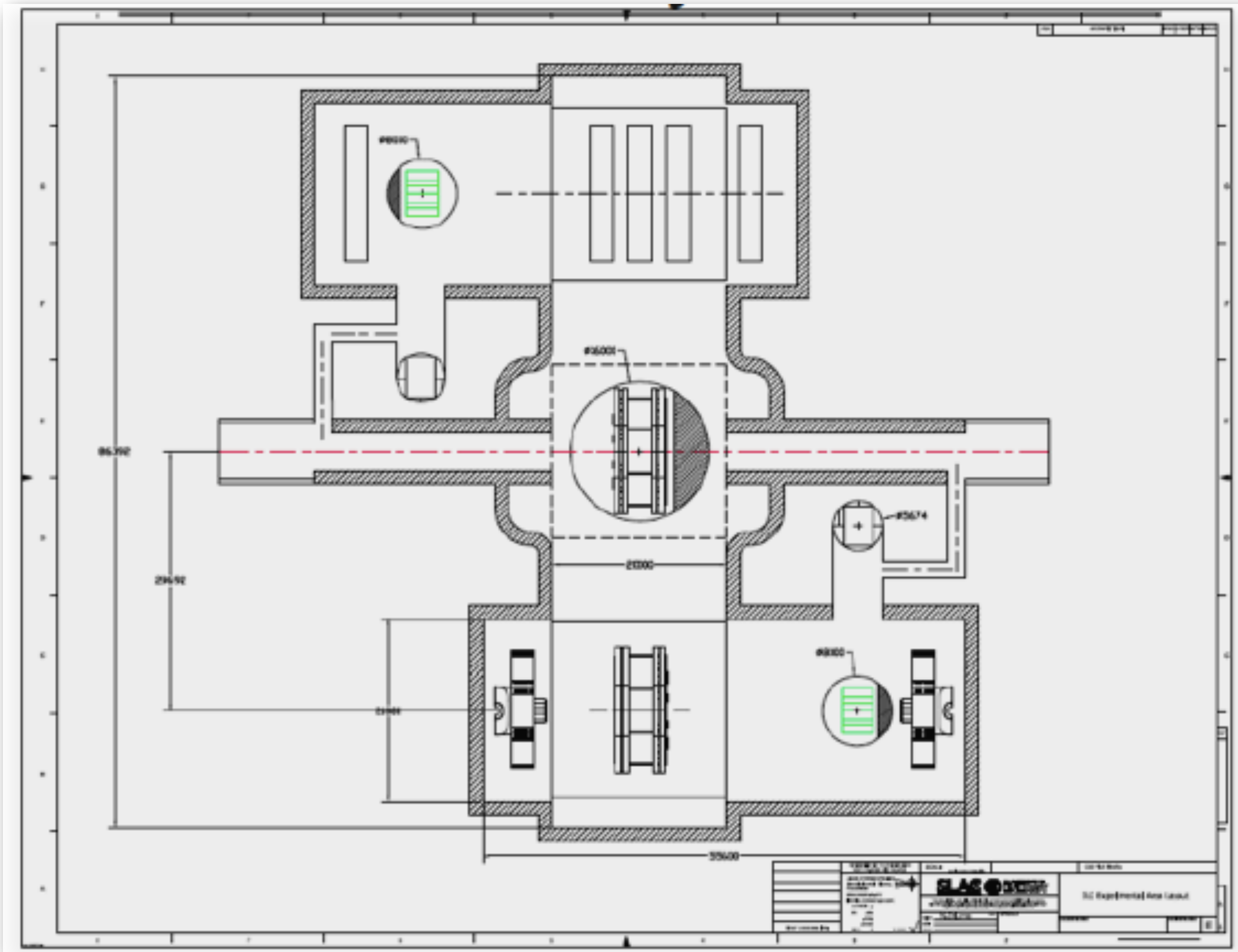
- Modification to the layout could reduce stresses
- Results can help to evaluate also other geologies

RDR IR Hall Layout

- Large (120m long)
- Shafts above experiments
- Not enough space in garage positions
- No space for services
- Not optimised for push-pull operations

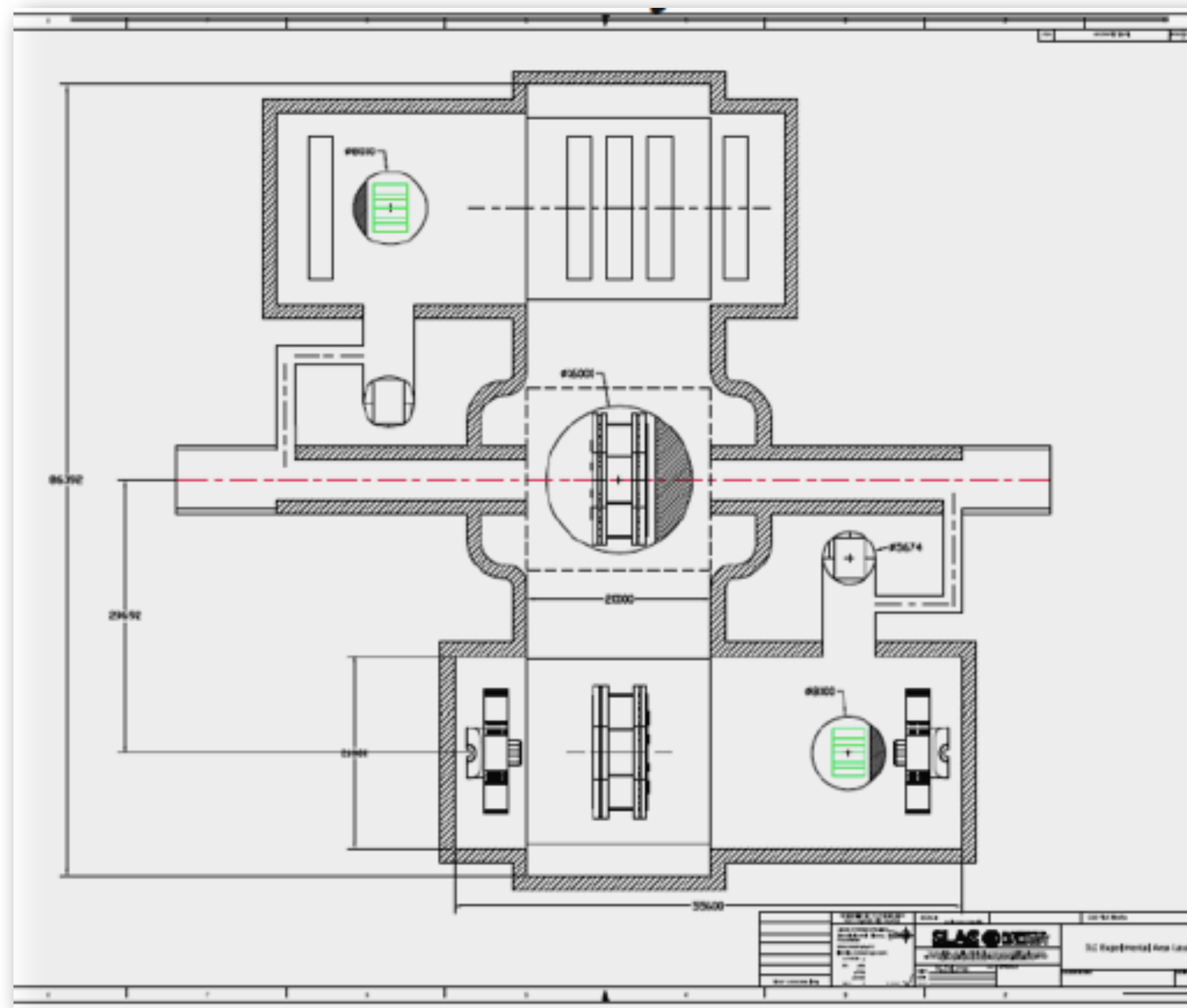


Latest IR Hall Layout

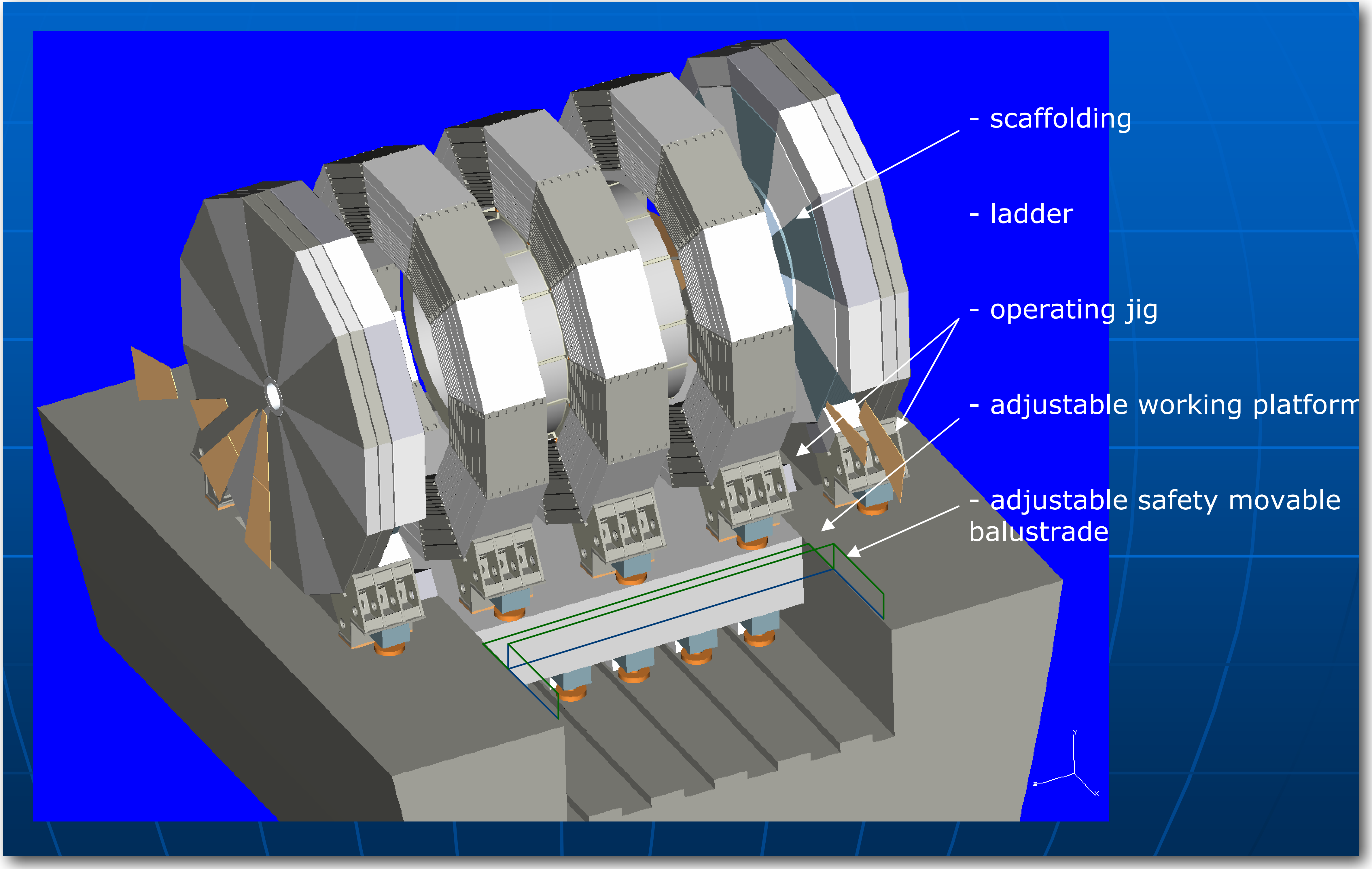


Latest IR Hall Layout

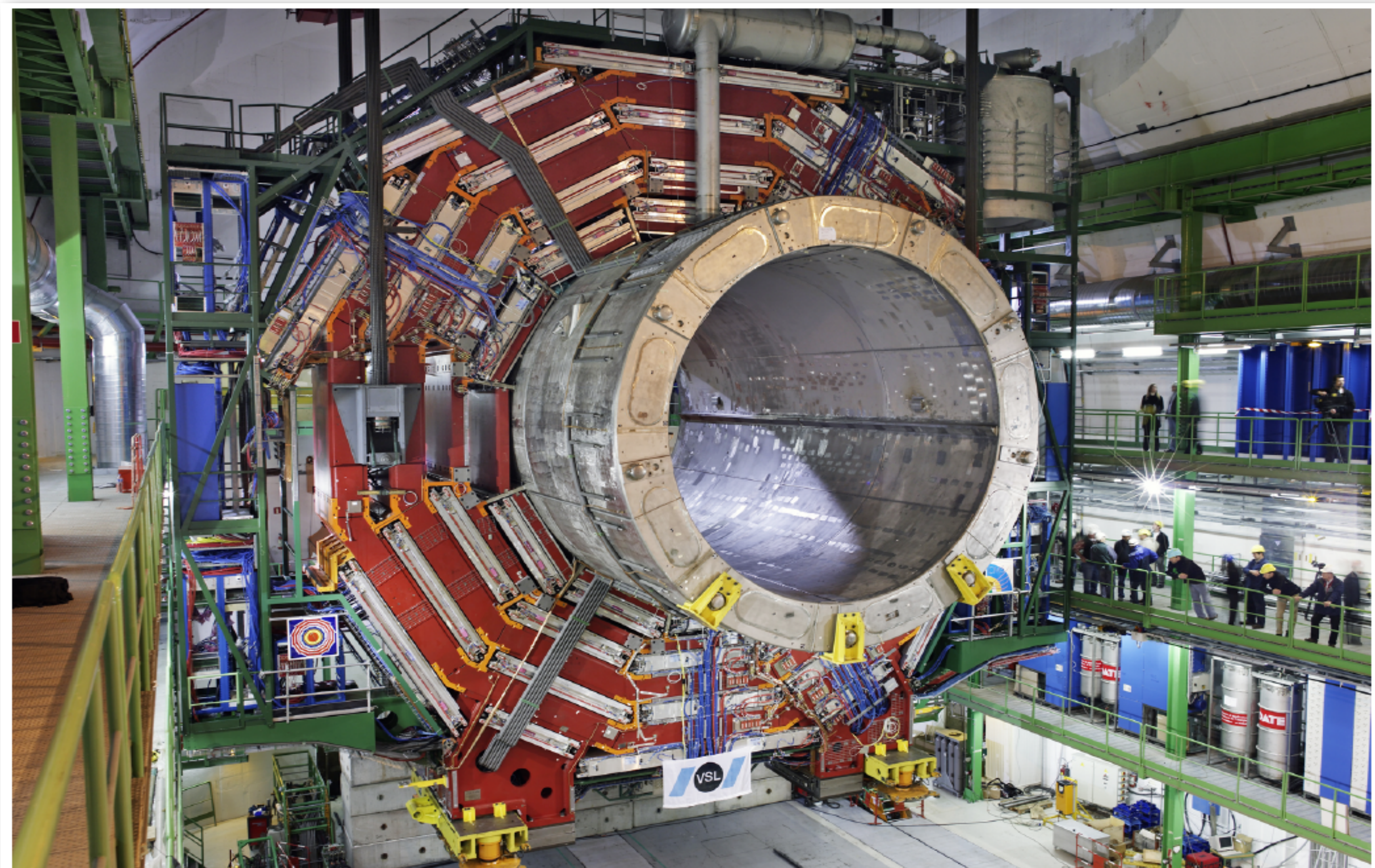
- Z-Shape
- Garage positions allow detector maintenance
- Only one large (~18m) shaft
  - used only in installation phase
- Maintenance shafts (~9m) in garage positions
- Small shafts for elevators (safety issues)
- Work in progress



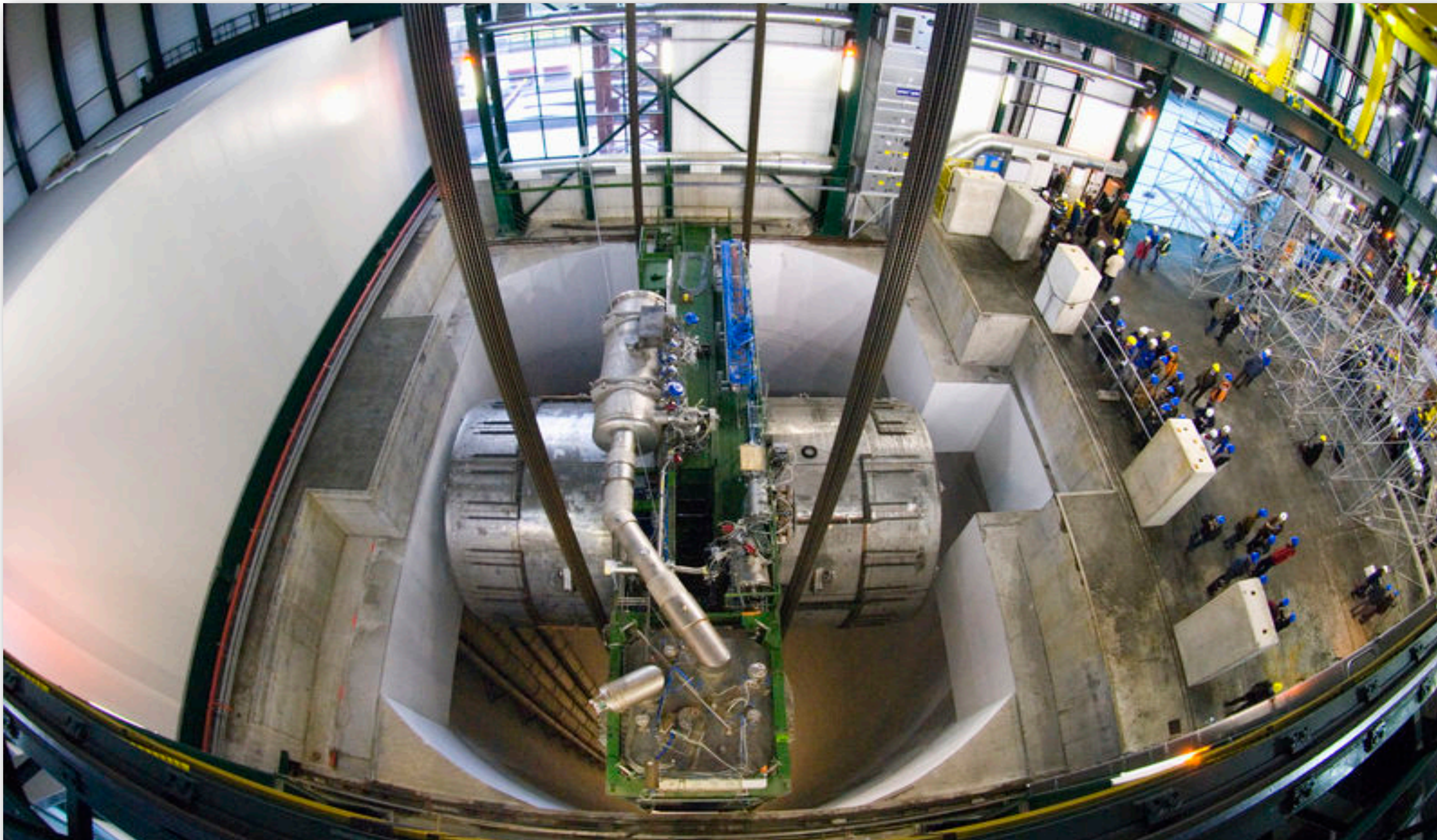
ILD in Maintenance Position



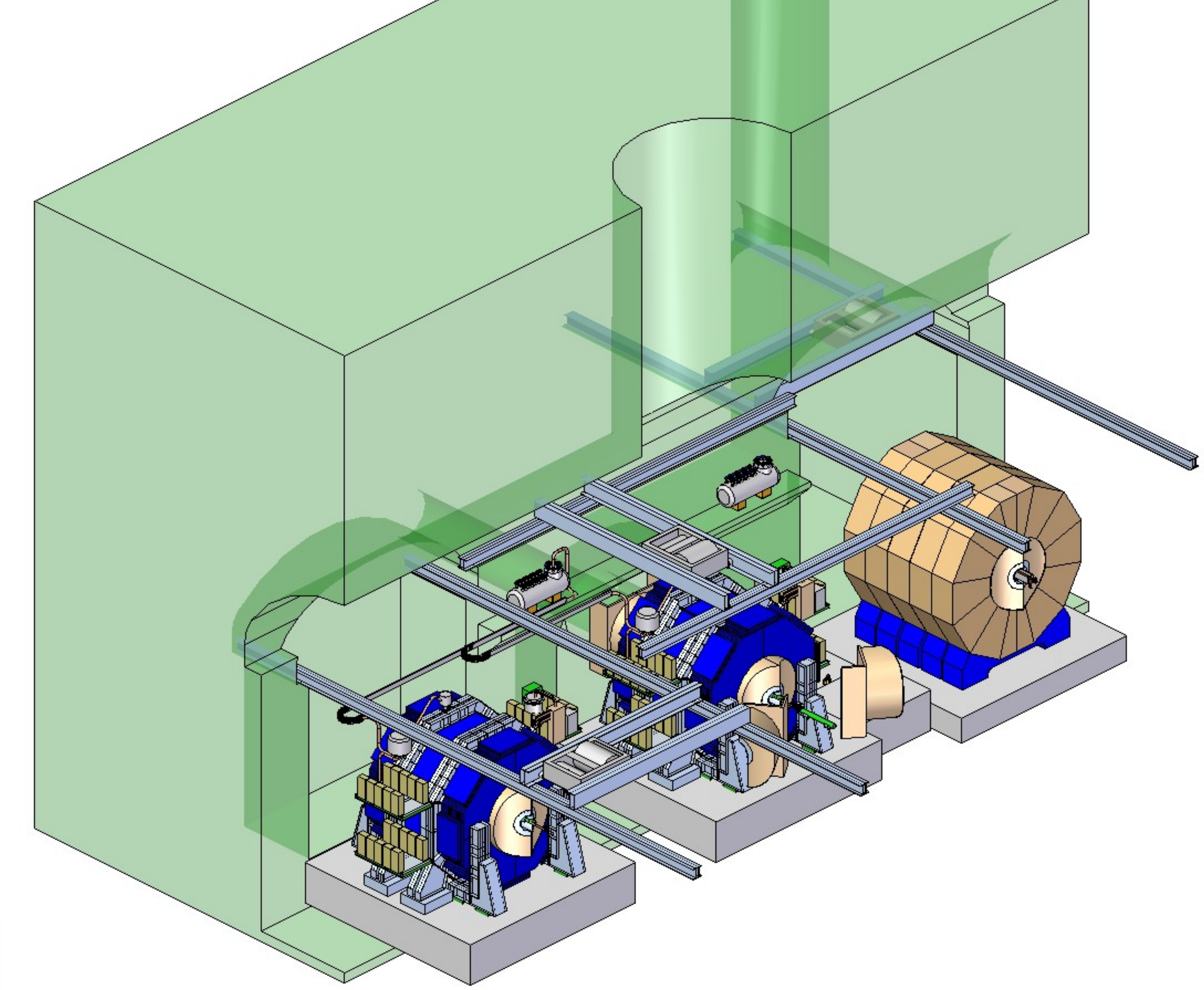
CMS Assembly

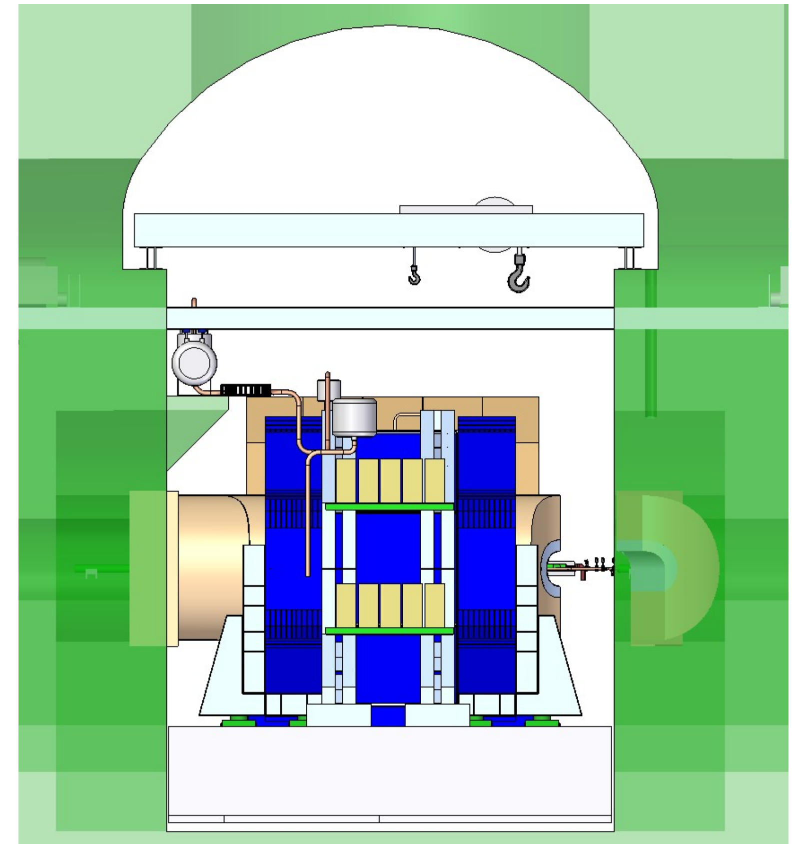


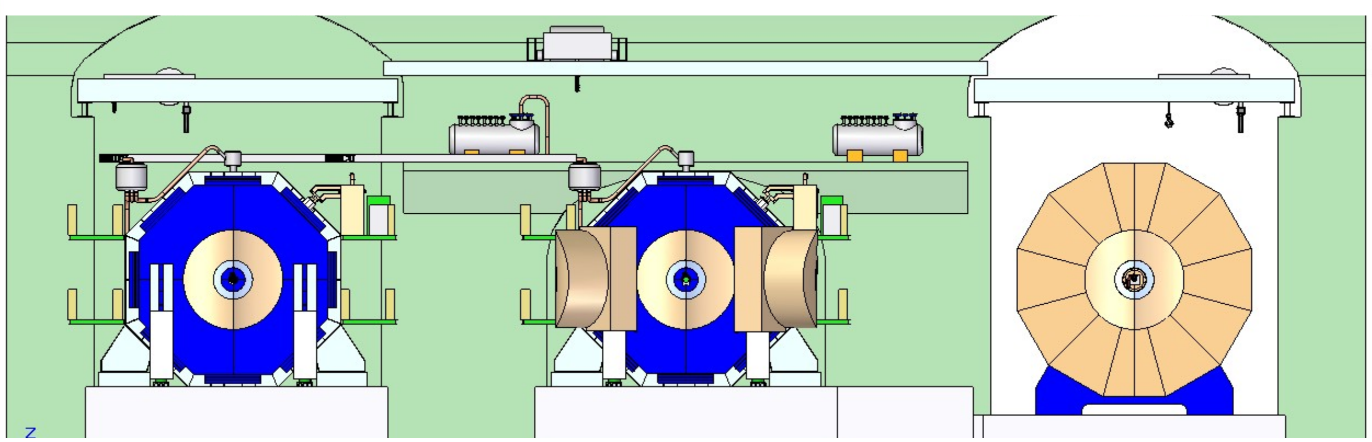
CMS Assembly

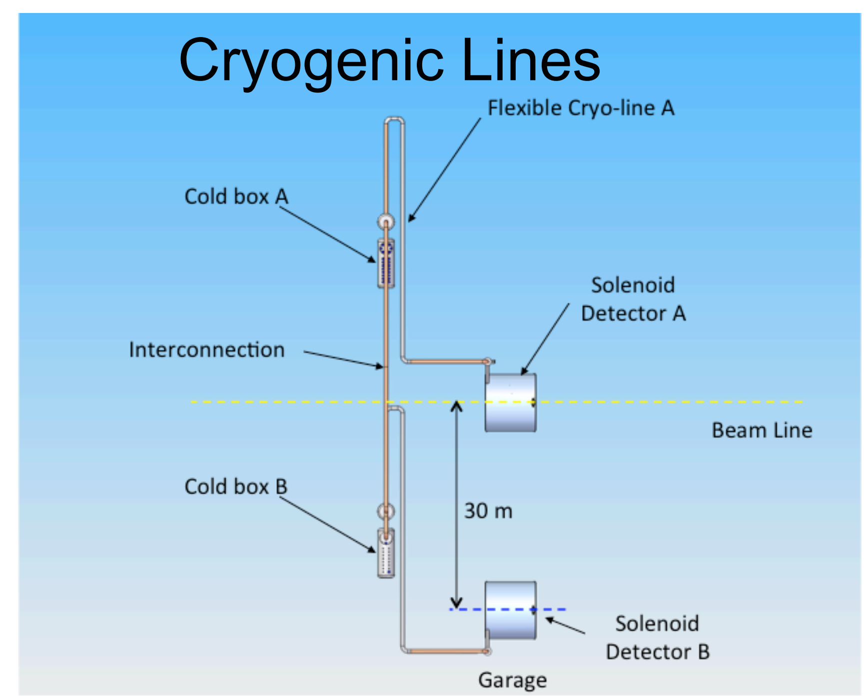


Cranes & Infrastructures arrangements, Undergound





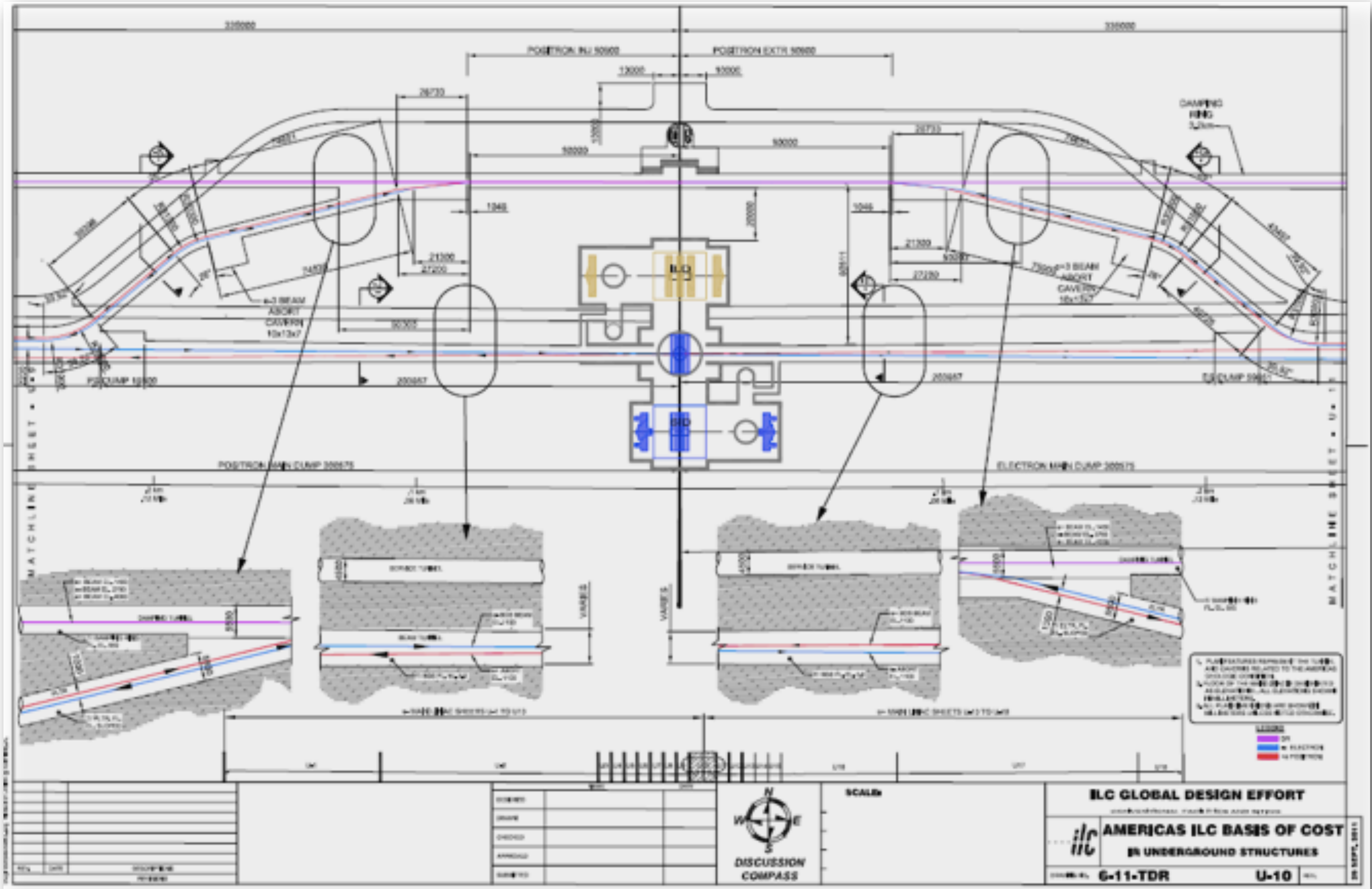




M. Oriunno

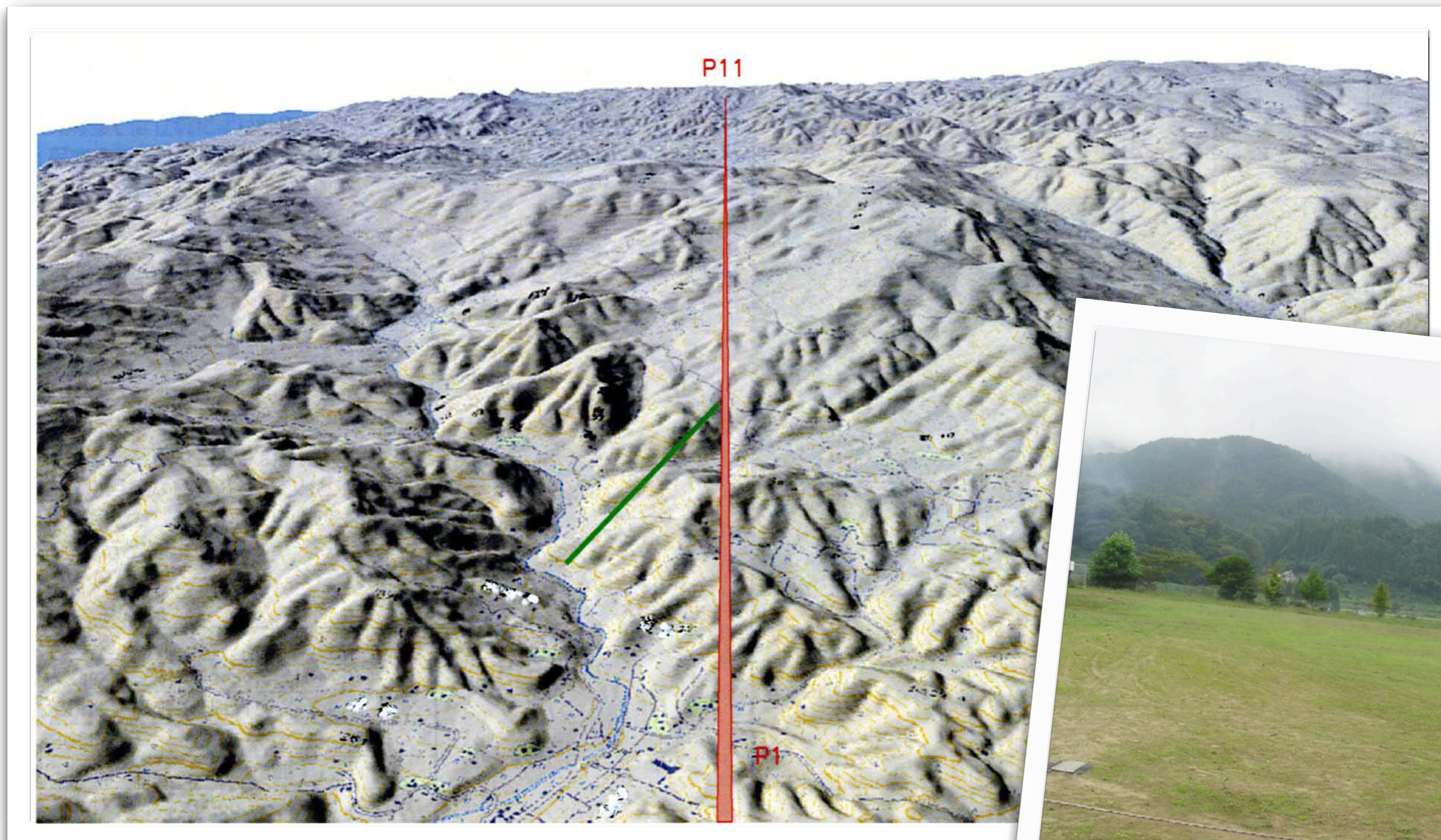
Detector service arrangements under study

Central Region Integration



Mountain Site Configurations

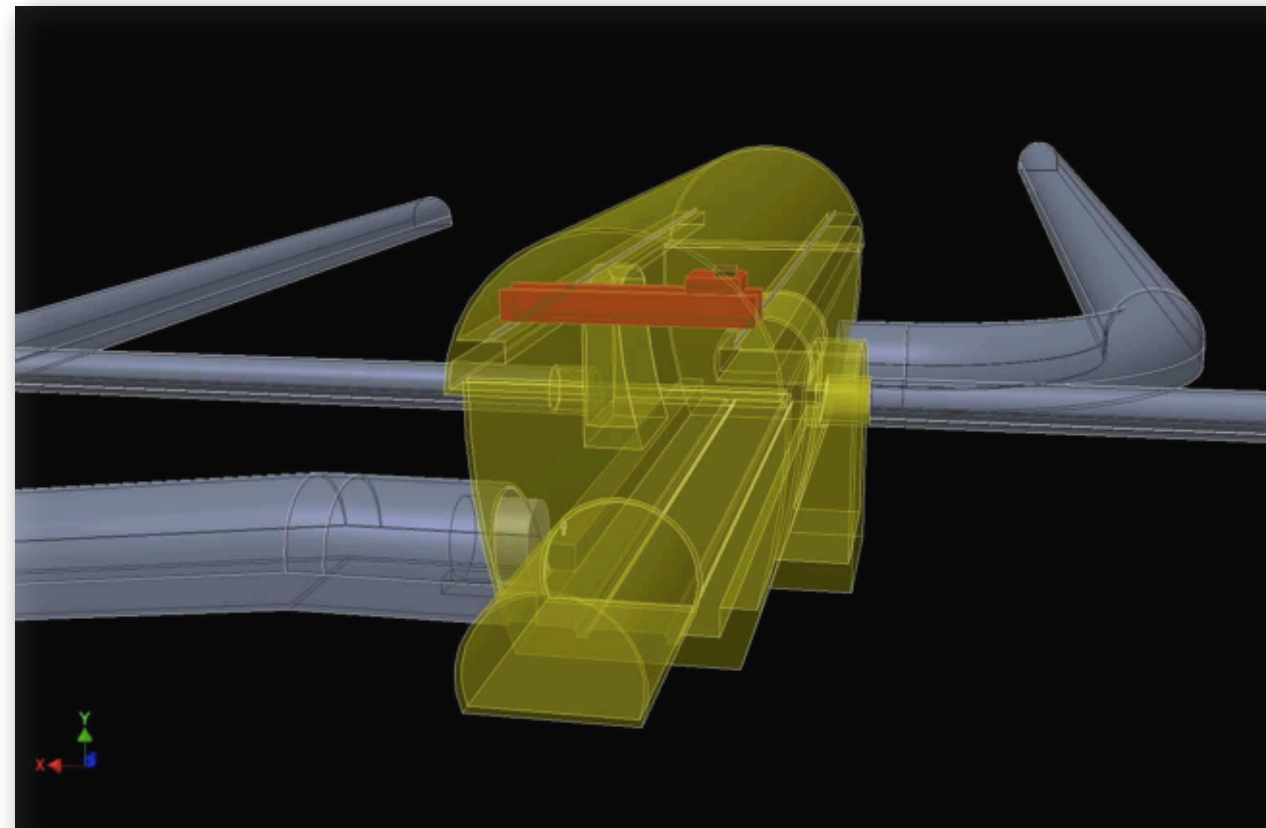
Y. Sugimoto

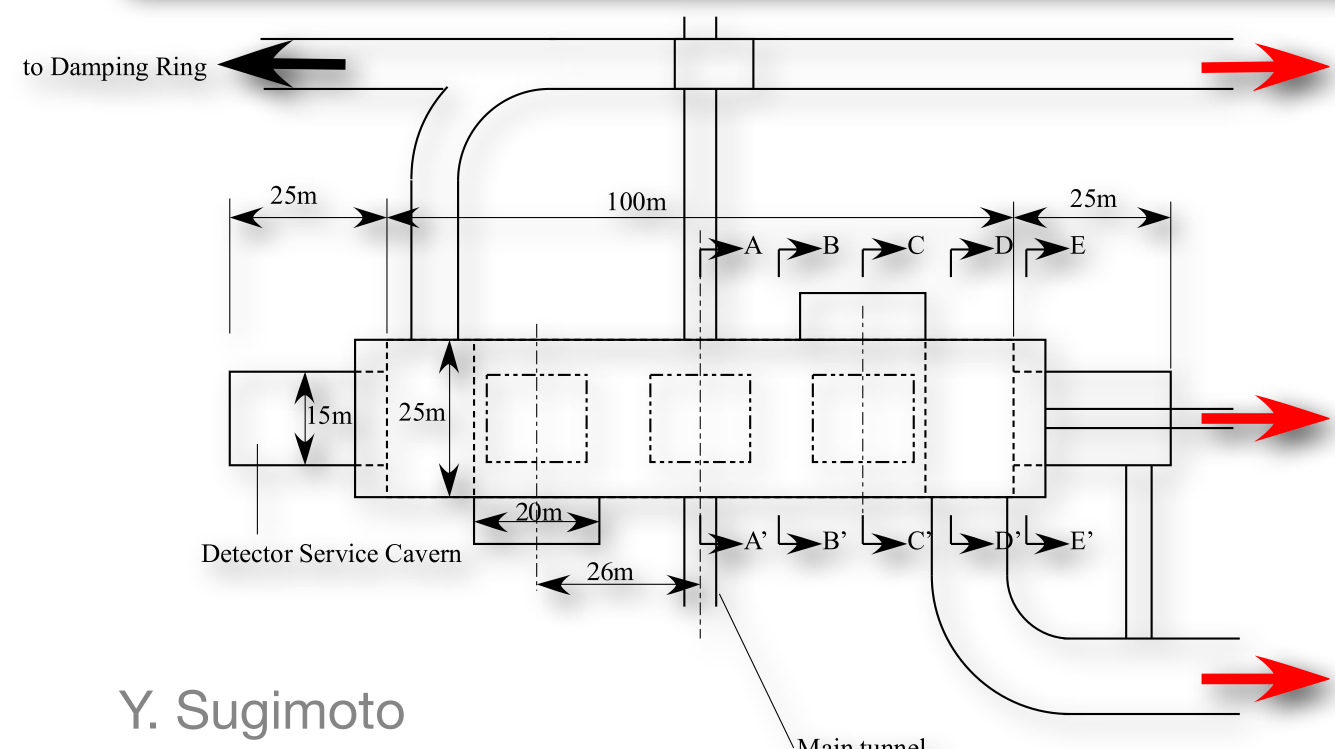


- No vertical access to IR

Possible Design of Experimental Hall

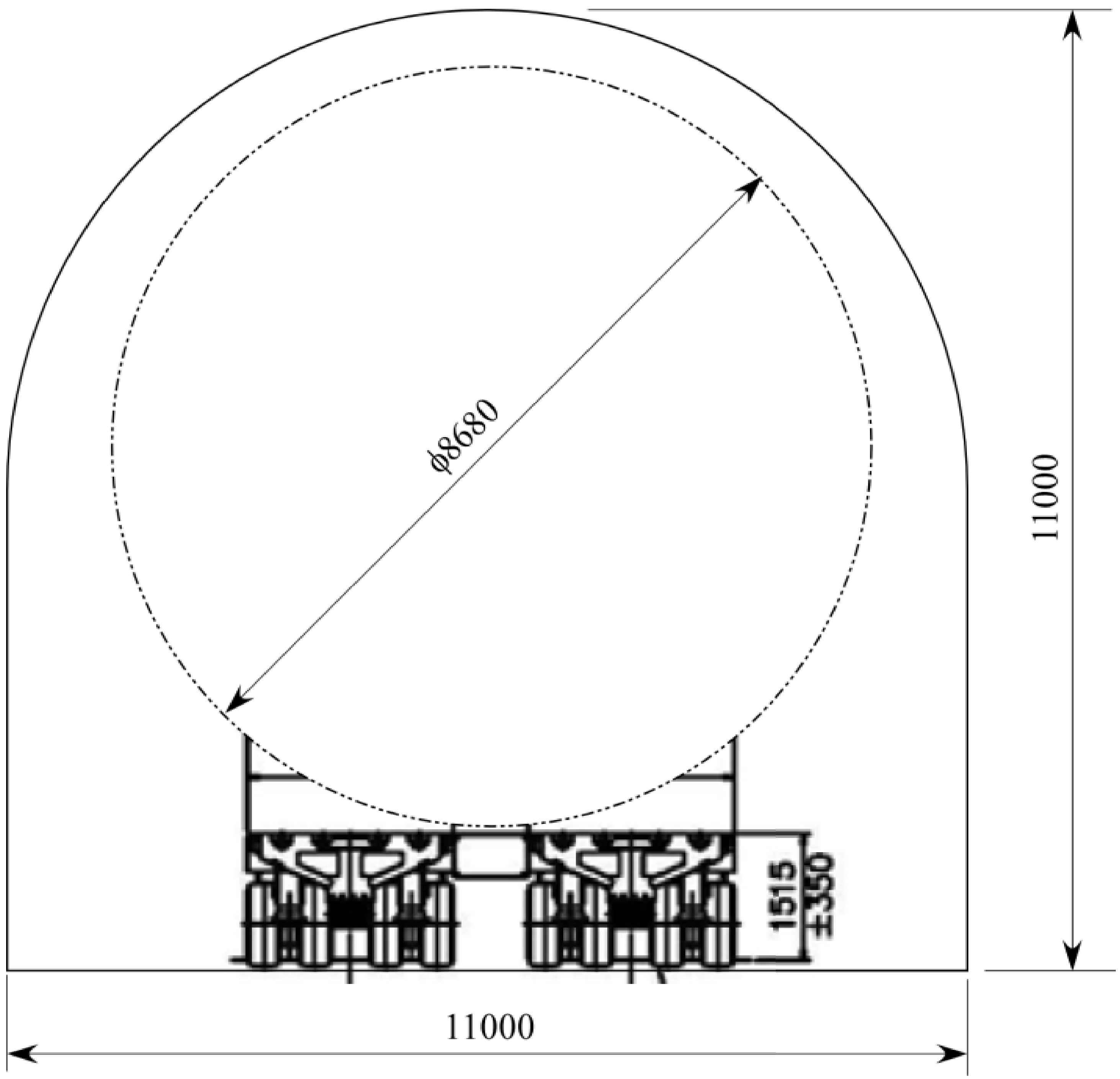
- Horizonal access tunnels
  - ~1km long, might have slope
  - limited in diameter
- Different detector assembly scheme
  - requires more underground space
  - modifications to the detector design
  - modification to the assembly and commissioing sequences of the machine and the detectors

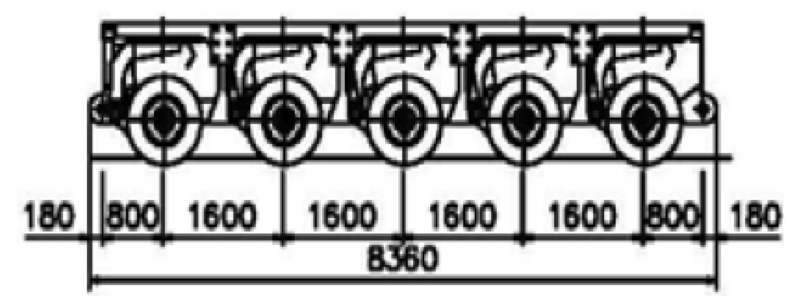




Y. Sugimoto

Y. Sugimoto





- 225t/5axles → 450t with 2-trailers
- Capable of ~7% slope

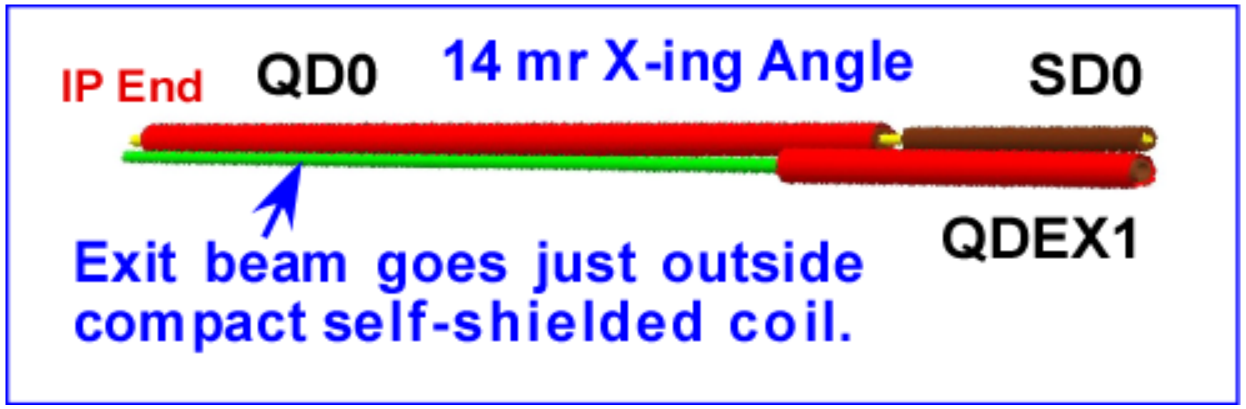
Access Tunnel Diameter

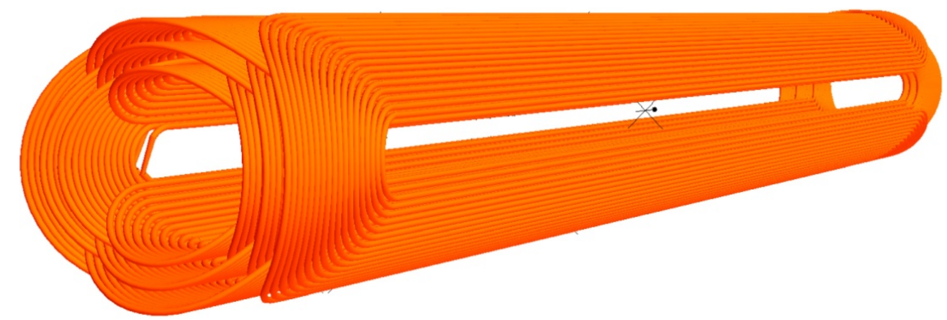
Biggest piece: solenoid coil

Mountain Site Considerations in MDI

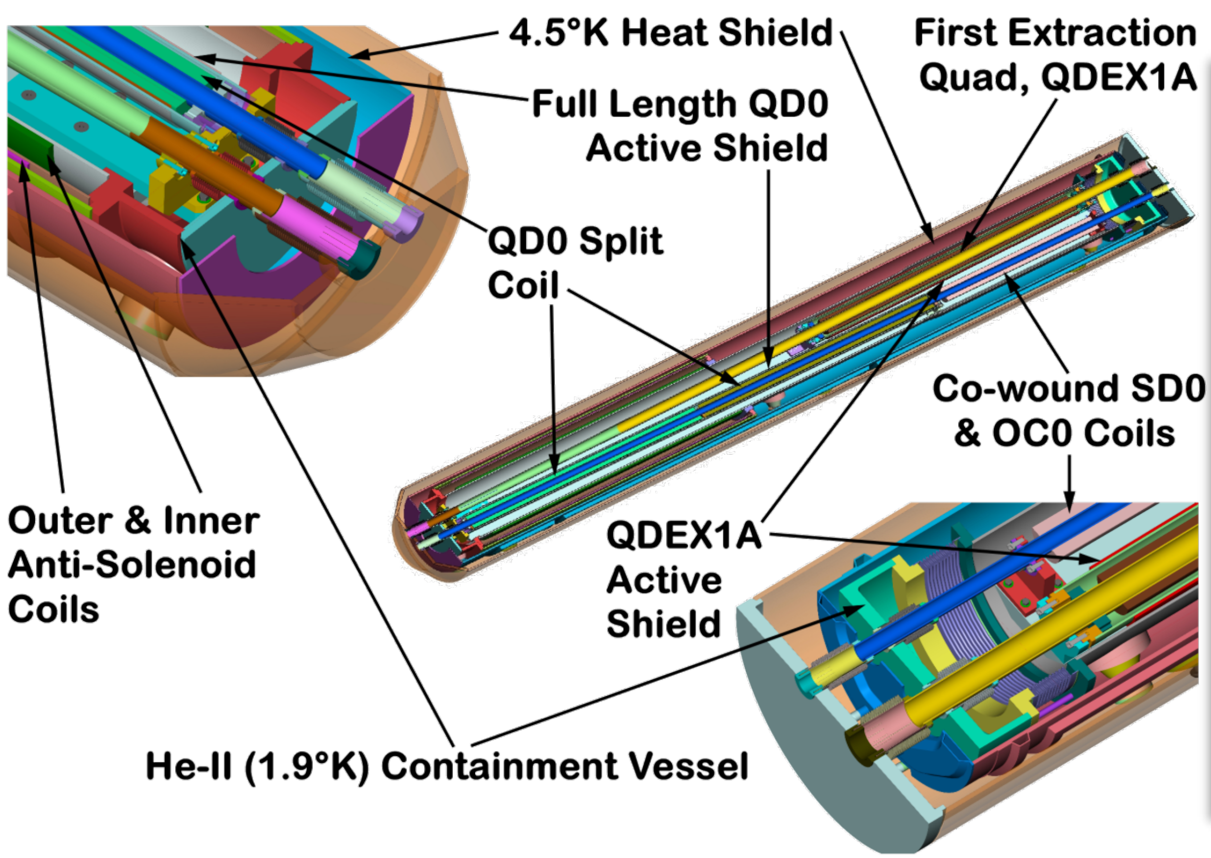
- Adaptations to the possible mountain sites in Japan have started
- This is a major endeavour for the detectors and the machine (CFS)
- Open points have been identified and are being worked on:
    - Hall and access tunnel design
    - Safety issues
    - Modification of detector assembly schemes

QD0 Final Focus Magnet Details





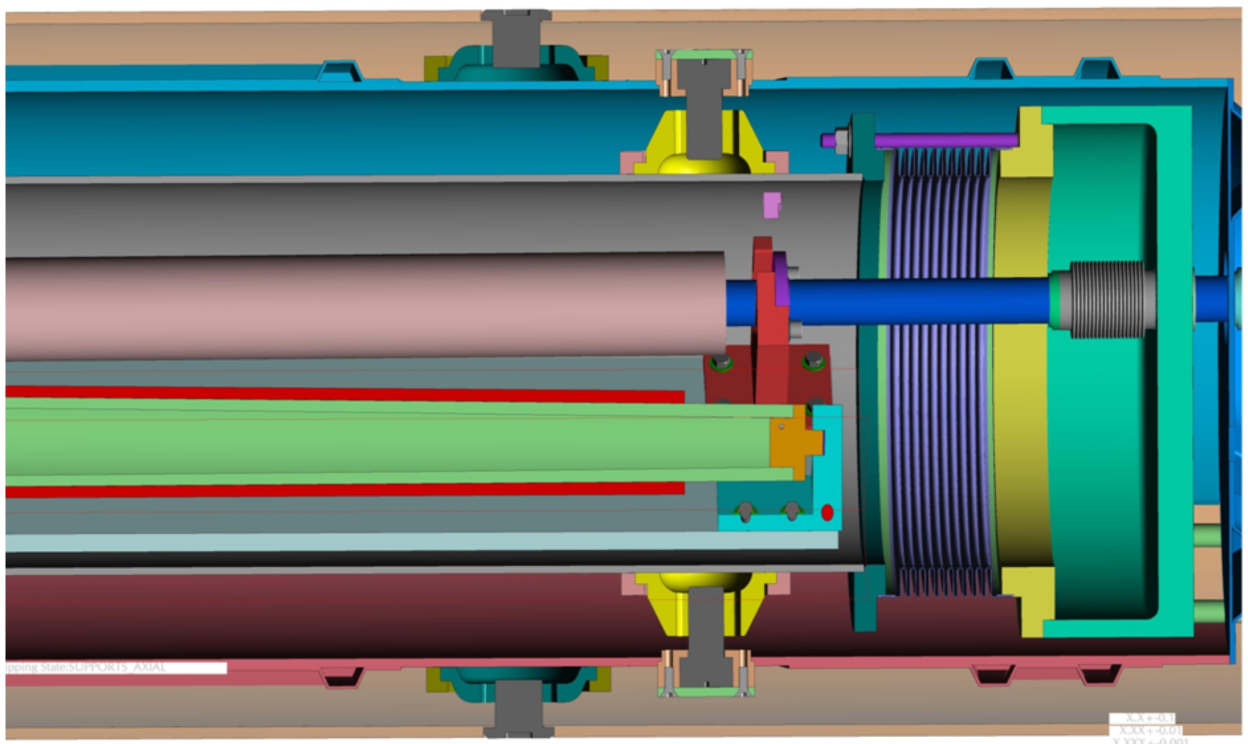
QD0 Coils in Opera3d



The QD0 magnet cryostat contains multiple actively shielded quadrupole coils, with sextupole and octupole coils, many correction coils plus an adjustable force-neutral anti-solenoid.

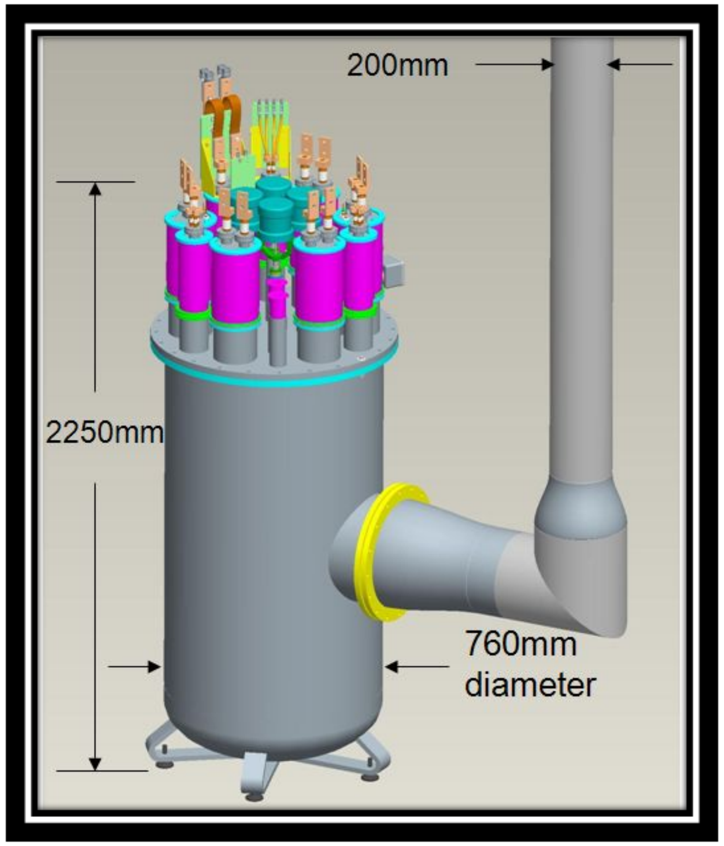
QD0 System Details

Cross Section Through Inner And Outer Supports



ILC Large Service Cryostat Design

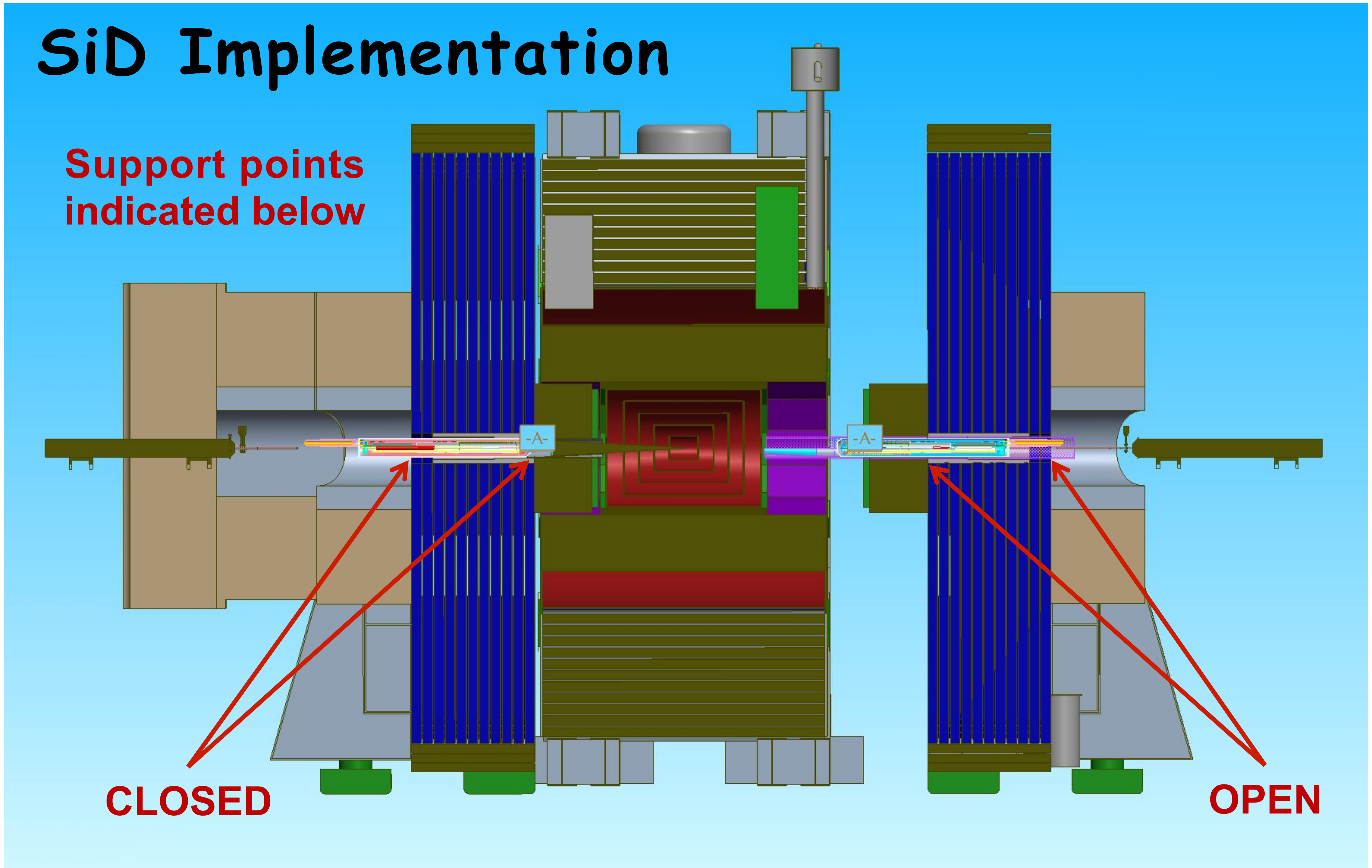
- 12 (1000 Amp) leads.
- 24 (100 Amp) leads.
- 150 instrumentation leads.
- Built to supply 1.8 K Helium to magnets 10 meters away.
- Complex and large but can be positioned remotely from the magnet.



Make integrated horizontal systems test of magnet & service cryostat and then characterize vibrational stability in as many independent ways as possible.

*Extracted from "Cryostat Design," Andy Marone, BNL.

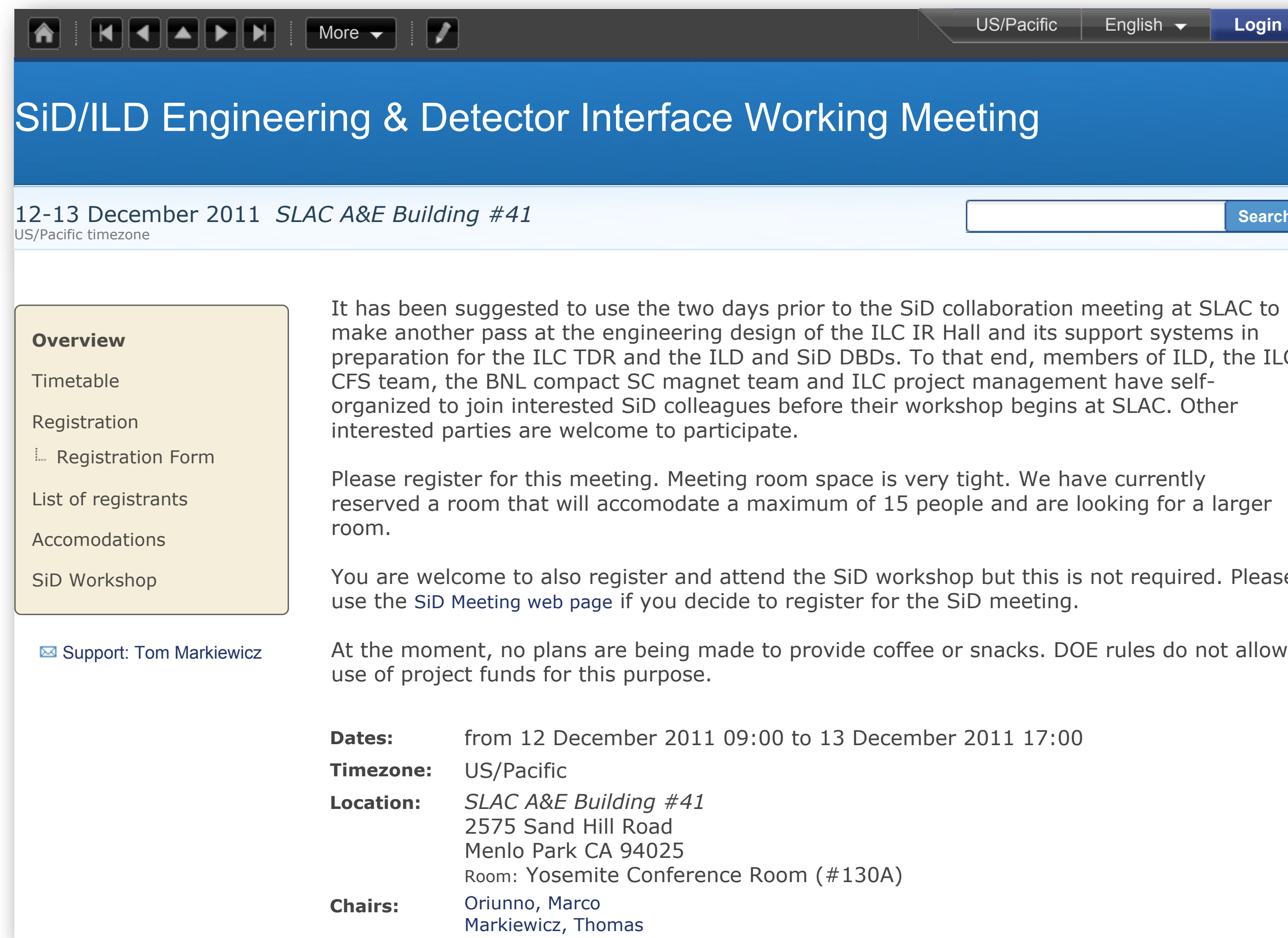
QD0 Interface to Detectors



*Extracted from “QD0 Support Tube B.pptx,” Bill Sporre email dated 27 September 2011.

Next Milestone

- Common ILD/SiD/ILC-CFS Workshop on engineering and civil facilities, December 2011
  - Includes discussion on QD0 and cryo requirements
- Agree to finalise the layout and dimensions of the IR civil facilities for the „standard“ ILC sites
- Status discussion on mountain site implications
- Finalise work plan towards the TDR/DBD



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SiD/ILD Engineering & Detector Interface Working Meeting

12-13 December 2011 *SLAC A&E Building #41*
US/Pacific timezone

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Accomodations
SiD Workshop

Support: Tom Markiewicz

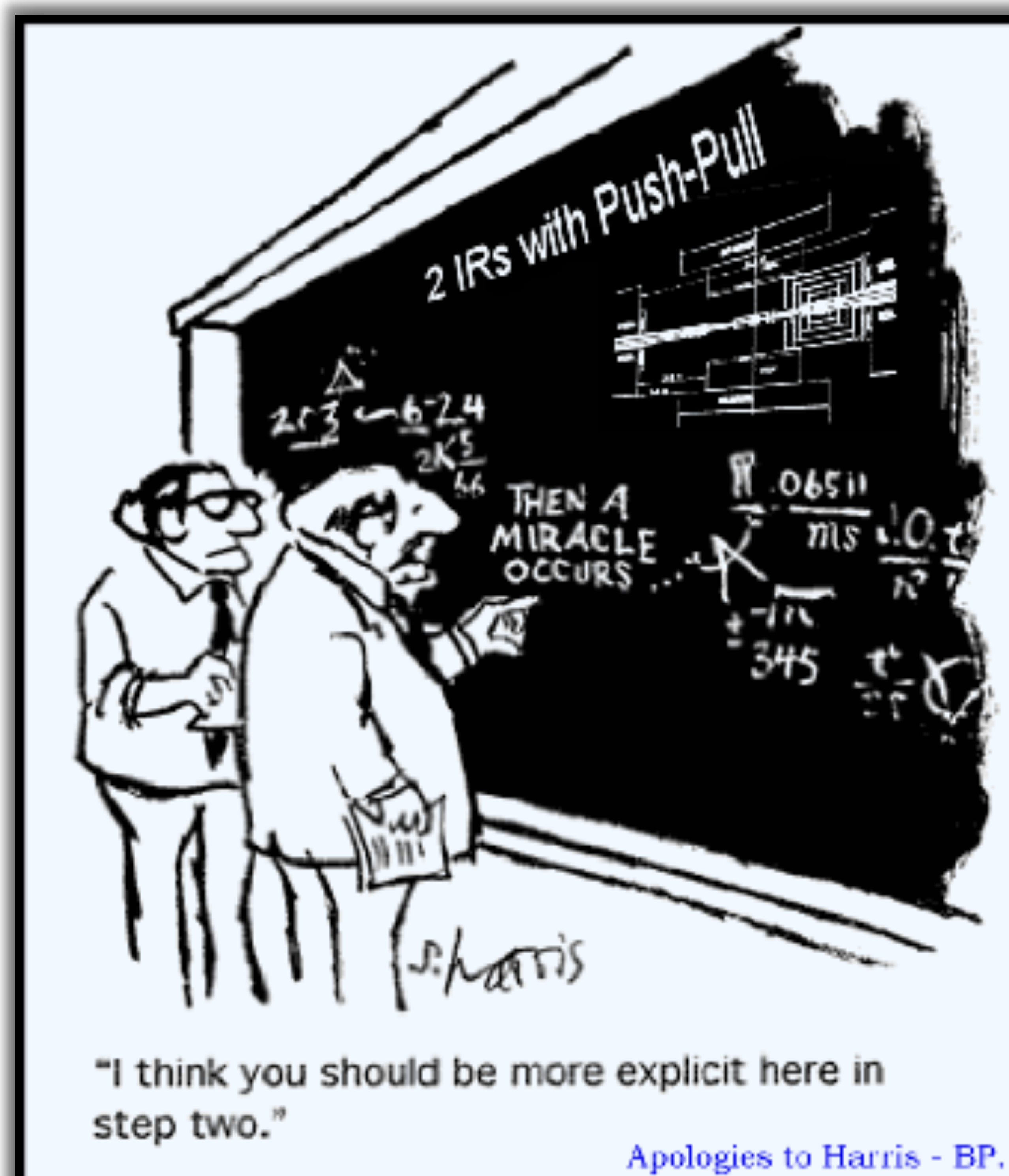
It has been suggested to use the two days prior to the SiD collaboration meeting at SLAC to make another pass at the engineering design of the ILC IR Hall and its support systems in preparation for the ILC TDR and the ILD and SiD DBDs. To that end, members of ILD, the ILC CFS team, the BNL compact SC magnet team and ILC project management have self-organized to join interested SiD colleagues before their workshop begins at SLAC. Other interested parties are welcome to participate.

Please register for this meeting. Meeting room space is very tight. We have currently reserved a room that will accomodate a maximum of 15 people and are looking for a larger room.

You are welcome to also register and attend the SiD workshop but this is not required. Please use the SiD Meeting web page if you decide to register for the SiD meeting.

At the moment, no plans are being made to provide coffee or snacks. DOE rules do not allow use of project funds for this purpose.

Dates: from 12 December 2011 09:00 to 13 December 2011 17:00
Timezone: US/Pacific
Location: *SLAC A&E Building #41*
2575 Sand Hill Road
Menlo Park CA 94025
Room: Yosemite Conference Room (#130A)
Chairs: Oriunno, Marco
Markiewicz, Thomas


2 IRs with Push-Pull
THEN A MIRACLE OCCURS ...
S. Harris
"I think you should be more explicit here in step two."
Apologies to Harris - BP.

B. Parker

Summary and Outlook

- MDI work is now a very productive collaboration between
  - SiD, ILD
  - GDE-CFS, GDE-BDS
  - CLIC
- Work concentrates on design issues that need to be finalised soon
  - TDR and DBD requirements
  - Cost drivers
- Engineering specifications require engineering studies
- Resources are tight